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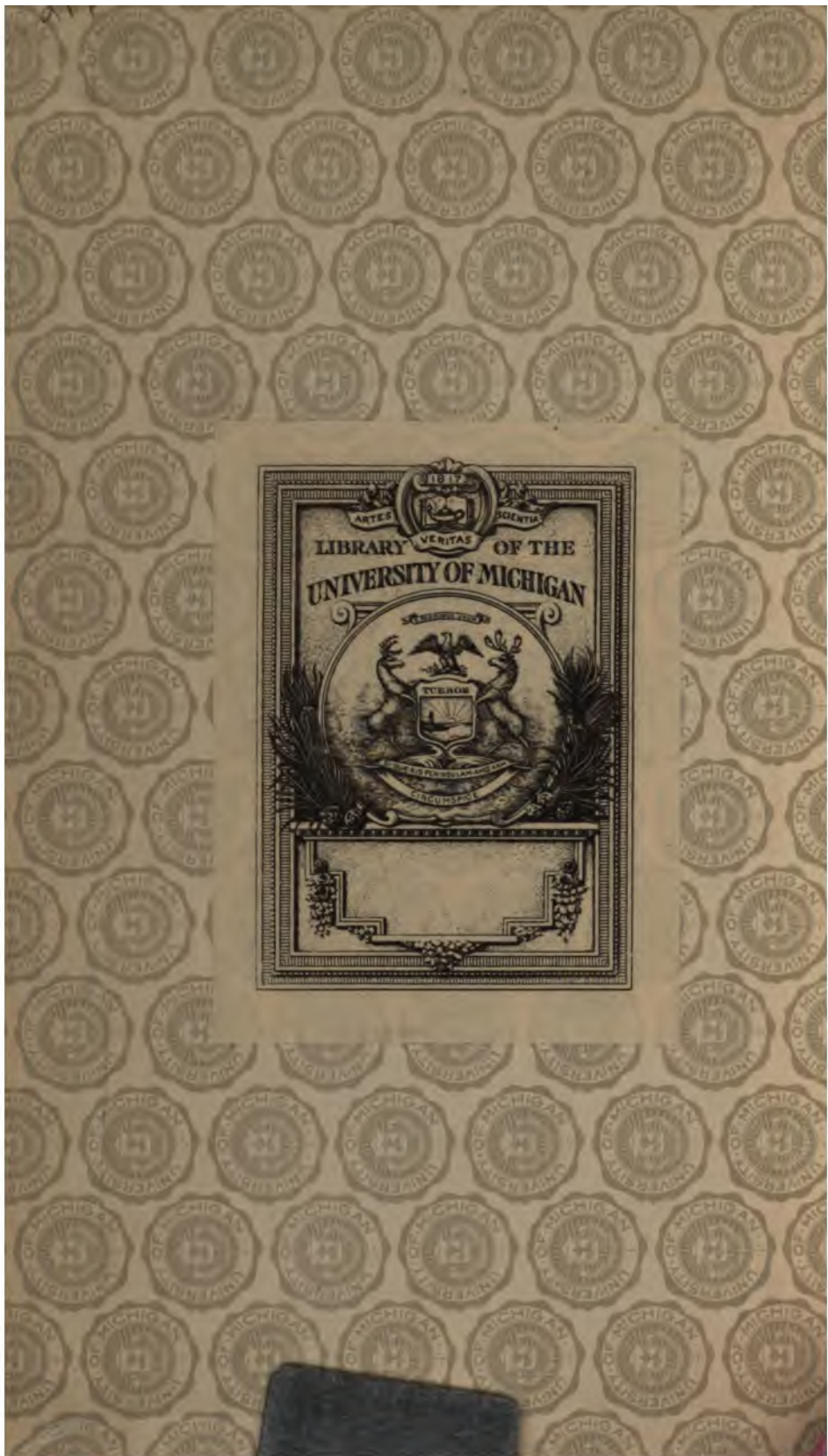
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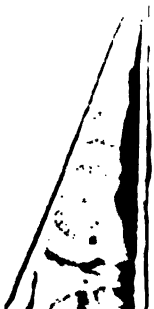
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BUREAU OF EDUCATION  
CIRCULAR OF INFORMATION NO. 1, 1890

CONTRIBUTIONS TO AMERICAN EDUCATIONAL HISTORY  
EDITED BY HERBERT E. ADAMS

No. 9

THE HISTORY

OF

FEDERAL AND STATE AID TO HIGHER EDUCATION

IN

THE UNITED STATES

BY

FRANK W. BLACKMAR, Ph. D.

SOMEWHAT FELLOW IN HISTORY AND POLITICS IN THE JOHN F. BOYD  
UNIVERSITY, NOW PROFESSOR IN THE STATE UNIVERSITY OF MICHIGAN

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## LETTER.

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DEPARTMENT OF THE INTERIOR,  
BUREAU OF EDUCATION,

*Washington, D. C., February 19, 1889.*

SIR: I have the honor to transmit the monograph on Federal and State Aid to Higher Education in the United States, prepared by Mr. Frank W. Blackmar, fellow in history and politics in the Johns Hopkins University, which represents the progress of the State idea in education from the foundation of the colonies to the present time. It shows the attitude of each colony and of each subsequent State toward colleges and universities, and recounts that part of the legislative and financial history which relates to advanced learning in the several commonwealths. The writer discusses the rise of national education, with its relation to local, and brings forward the opinions of statesmen and scholars concerning the duties and functions of the Government in public education. A brief history, accompanied by valuable statistics, is given of the various methods adopted by Congress to encourage and assist institutions of learning. But the main body of the work is devoted to the presentation in a condensed form of the plans pursued by the Legislatures of thirty-eight States in the treatment of higher education. The monograph represents a wide range of research, extending from the earliest colonial records and charters to the latest revised statutes.

Many inquiries of late coming from statesmen and educators for information on this subject, have created a demand for a work of this nature. There is a desire on the part of the scholars of each State to see what has been done in other States, that mistakes may be avoided by experience and the best plans and models followed. There is, likewise, a general desire for a closer study of school management and school systems, based on wider information and more careful comparison of methods and results. The financial and legislative history of education furnishes a foundation for such study and comparison. The successful management of the means of education is of prime importance; without this there is danger of complete failure. The control of the budget is the control of the State; this principle applies to institutions as well as to nations. State education has taken a strong hold, particularly in the South and West, but the problems pertaining to its management, its function, and its support, have not yet been fully solved.



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To bring the results sharply and clearly before the reader have been used quite freely, while to bring the monograph to compass much interesting and instructive material much which would find its way into a general history of education and hard facts after all are the most enduring portion will remain, if collected with care and with a single aim exact truth whatever be the consequences, when the column men have thrown on truth in the name of history has "The statistician," says the Hon. Carroll D. Wright, "and may be an unlovely setting, but he knows it will be all time." This monograph was written with an earnest sentiment facts, and not with a view to prove any particular

History of this sort ought to help us better to understand national work as it is; it ought to dispel illusions and for Americans we are accustomed to indulge ourselves in sentiment that borders on boasting when we speak of our institutions. It is a favorite pastime with many to imagine particular local institution is the best in the State, or the nation, and that our system of higher education is equal to any in the Old World. The criticisms of men like James the late Matthew Arnold, though strongly presented, are true, and are exceedingly helpful toward a better understanding position. When applied to education they ought to go to higher culture and to a more elevated standard. It is idle to ourselves by making our system appear greater than it is, so many poorly endowed and half-equipped colleges and our country, and so many thousand illiterate citizens are

To bring the work of the several States into comparative unity of sentiment and unity of design in education, and for patriotism and nationality. The influence of a single on the founding and organization of others, is well illustrated an institution as the University of Virginia or as the Michigan. A constant and persistent publication of higher education in all of its phases will do more to harmonize national systems than almost any other thing. As a mere local distinctions it is next to a university composed of parts of the United States. Higher education needs to be and harmonized.

One of the strongest inferences that may be drawn from the fact that in nearly every instance the foremost desire has been for colleges and universities, rather than for schools of grade. It was the opinion of the colonists and of the leaders of the West and South that primary and secondary schools were essentially dependent for their existence upon higher institutions. The principle is borne out by the facts, for, then as now, where colleges and universities are, there will be found the best

mary and secondary schools. It is not uncommon to hear persons speak of common schools and the university as if they were entirely disconnected, and what concerned one did not concern the other. Our fathers meant by a "common" or "free" school one that was open to all persons on equal terms, and not necessarily a school of low grade. The meaning of the terms has changed, but it would be well to return to their primitive signification, and consider all schools, colleges and universities, high schools, secondary and primary, whether State or non-State, as schools of the people; and to consider further that what affects one class affects all, and that to build up and strengthen higher learning is the safest plan for insuring the perpetuity of primary and secondary schools.

This monograph was prepared at the request of the Bureau of Education by the author, under the supervision of Dr. Herbert B. Adams, of the Johns Hopkins University, and is one of the series upon the history of higher education in the United States authorized by you. I respectfully recommend its publication.

Very respectfully, yours,

N. H. R. DAWSON,  
*Commissioner.*

Hon. W. F. VILAS,  
*Secretary of the Interior, Washington, D. C.*

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**DEPARTMENT OF THE INTERIOR**  
*Washington, D. C., April 11*

**The COMMISSIONER OF EDUCATION:**

**SIR:** I acknowledge the receipt of your letter of February in which you recommend the publication of a monograph on and State aid to higher education in the United States.

Authority is hereby given for the publication of the monograph provided there are funds in sufficient amount available for such

Very respectfully,

**JOHN W. NOBLE**  
*Sec*



## AUTHOR'S PREFACE.

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One of the chief difficulties encountered in writing the following monograph, has been to determine what schools should be classified as institutions of higher education. When treated historically higher education is quite relative in its nature. There is no line that can be drawn separating into groups schools of the same grade of work. The names of institutions are misleading; an old time academy might have been equal in curriculum and instruction to a modern college, and on the other hand a modern high school may be equivalent to an old time college. There has always been a tendency for an institution, when first founded, to take upon itself a great name with the hope of soon becoming greater than its name. All classification is at best merely relative. Under such circumstances there is only one alternative—to classify institutions appearing under the names of “college” and “university” as schools of superior instruction.

On the other hand, many normal schools have courses of instruction ranging into the classics and higher English branches. But as these schools are professional, being devoted to the preparation of teachers in the primary and secondary schools, they are naturally excluded from the classification under higher education. They should be treated by themselves, and it would be exceedingly interesting to trace the history of normal education in the United States.

The question of determining the position of pure agricultural and technical schools, where the chief work has been directed to manual training rather than to theoretical knowledge, is not easily settled. In this monograph the agricultural and mechanical colleges have been included, as upon the whole the best solution of the question.

The educational institutions for the deaf, dumb, and blind, though State schools, do not come within the range of this paper, being usually classified under “Charities.”

Many schools have been discussed which are, strictly speaking, to be excluded from the classification of superior instruction, but their intimate historical connection with schools of advanced learning renders it necessary to give them brief mention.

The difficulties attendant on the presentation of a subject extending over such a wide range of topics may be readily discerned.

The chief sources employed by the writer are as follows: (1) Catalogues, regents' reports, and collateral material, chiefly found in the

library of the Bureau of Education ; (2) the reports of the State superintendents and secretaries of Boards of Education ; (3) the Constitutions and charters of States ; (4) the revised statutes of the States ; (5) the United States Statutes at Large ; (6) Congressional literature ; (7) the acts of the Assemblies of the several States for each year ; and (8) the colonial laws and records. Useful articles in the magazines and periodicals and pamphlets containing public addresses have been suggestive and helpful.

There is also a series of monographs to which the writer has given especial attention. Included in this series are the following : The College of William and Mary, by Dr. H. B. Adams ; Thomas Jefferson and the University of Virginia, by the same author ; History of Education in North Carolina, by Charles Lee Smith ; History of Higher Education in South Carolina, by C. Meriwether ; Education in Georgia, by Charles E. Jones ; Higher Education in Indiana (MS.), by James A. Woodburn ; Education in Louisiana (MS.), by Edwin S. Fay.

There is another class of works that has been useful, including such books as Hough's History of the University of Missouri ; Bush's History of Harvard ; Ten Brook's History of Michigan University ; Smith's History of Dartmouth ; Moore's History of Columbia ; Smart's History of the Schools of Indiana ; Wickersham's History of Education in Pennsylvania ; La Borde's History of South Carolina Colleges, etc.

The writer is indebted to the Superintendents of Public Instruction and the presidents of State colleges and universities for valuable information, and desires to acknowledge the courtesy of Dr. G. Brown Goode, of the National Museum, of Col. N. H. R. Dawson, of the Bureau of Education, and Professor Newcomb. The writer has received valuable assistance in the preparation of this monograph from Messrs. Charles Haskins and Robert J. Finley, of the Johns Hopkins University.

F. W. BLACKMAR.

*Johns Hopkins University,  
Baltimore, February 17, 1889.*

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# THE HISTORY OF FEDERAL AND STATE AID TO HIGHER EDUCATION IN THE UNITED STATES.

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## CHAPTER I.

### THE DEVELOPMENT OF STATE EDUCATION IN THE UNITED STATES.

#### EARLY COLONIAL EDUCATION.

There is no finer vista of political progress in the development of the American republic than that afforded by the changing views of education sustained by the people, and constantly modified by marked political tendencies. There is no better example of the influence of politics upon culture and learning than that presented by a historical perspective of the ideas which have developed our great educational system.

The colonists held learning as a sacred trust which they had brought from the Old World to be preserved and transmitted to posterity. They held it alike sacred to the best interests of the church and the society of a new community. But in this early period a decided political tendency in education was wanting; that is, a tendency toward that which educates the individual as a sovereign citizen and prepares him for the duties of the State. The relations of the church and the Government were very close in colonial days, and the control of the individual was frequently effected by the direct influences of both institutions. His duties in society were exactly and minutely specified, although it had not yet dawned upon the local communities that they were to become the component parts of a great republic, and consequently the political dangers of uneducated masses were not fully apprehended until the rising of the national spirit. Almost without exception the colonial governments, either through chartered rights and privileges or by means of self-government, made provisions for education by granting privileges and charters to private schools, or by establishing schools and colleges by legislative enactment to be supported in part by taxation. However, it required the united efforts of the colonists, through the church, the Government, and private benevolence, to keep learning from being "buried in the grave" of their forefathers.

It must be remembered, too, that the educational as well as the political institutions of the colonies were parts of European civilization removed across the Atlantic, here to be further developed under new conditions according to the needs of nascent States. The germs of educational systems were transplanted to a virgin soil, where, under the benign influences of free political institutions, they grew up, gradually differentiating from the old stock under the influence of new environments. The first schools in America were like those which the colonists had known in the mother countries, while education had in a great measure the same aim. The "grammar schools" of New England were modeled after the grammar schools and middle schools of old England, while the New England academies were legitimate survivals of the "great public schools" of Rugby, Eton, Westminster, and Harrow. The first colonial colleges, such as Harvard, William and Mary, Yale, Columbia, and Dartmouth were practically patterned after the old classical colleges, whose forms and curricula may be traced back to mediæval influences. But lacking in endowment, and in the support of intellectual and moral forces, these schools, planted in a new country, could not approximate to the excellence of their models in the Old World. Realizing the situation, the colonial governments came immediately to the assistance of these schools in New England and furnished a revenue by means of taxation.

At the time of the founding of the Dutch and Swedish colonies, the church in Holland and Sweden was a state institution to which education was intrusted. Hence we find the schools in these colonies following the policy of the mother countries, by giving into the care of the church the education of youth. The church edifice was the primitive school-house, and frequently the pastor of the church, the school-master. After the beginning of English dominion over the Swedish and Dutch territory, things were somewhat changed, although the old schools in many instances continued for a long time. Penn's frame of government, drawn in England before the settlement of the English colonists, authorized schools on the English plan, and it was doubtless intended that aid should be given them by revenues raised by taxation. For a long time, however, the chief work of the assembly was to create aid not to support the schools; for they were maintained both by the church and private enterprise.

The school organized by Benjamin Franklin, however, determines the colonial policy in its developed state—that of creating the school and assisting private benevolence in its support.

Colonial Virginia inherited a university created in England, endowed with land, and supported in part by subscription and donations. The ground for the university was surveyed, but before it could be located a devastating Indian war swept away the entire scheme. But the type and policy of the original movement may be seen in the later-formed William and Mary College, which was supported by private aid,

by taxation, and by royal endowment. The institution and the church were closely united, and the colony contributed to the support of both. Maryland followed closely in the footsteps of Virginia, first in the support of the Virginia college, and secondly in the support, by taxation, of schools founded by subscription, created by the government within her own territory. These county schools were State institutions according to the definition of the term in those days, and afterward made possible the colleges of Washington and St. John, with their State endowments. Farther south, in the Carolinas and in Georgia, we find the same general plan and purpose of education. The schools were modelled after those of England and were considered to be the charge of the colonial government. But as elsewhere noted<sup>1</sup> the schools did not flourish in the sparsely settled Southern districts as well as they did in the village communities of the North.

The dominant spirit in early colonial education was benevolence. Its whole force was spent on the moral elevation of society and on the support of religion. Theology was taught in nearly every college, and the propagation of the Gospel was an important factor in all education. By those who legislated from across the water in favor of education, the benighted colonists and the rude Indians were viewed in the same charitable light. And yet in every instance in which the colonial governments touched upon education, they considered it a legitimate function and part of their solemn duty to create schools, control them if need be, and support them when necessary. Particularly was this true of higher institutions of learning. Schools of lower grade might be carried on by the single efforts of individuals under sanction of the government, but the investments necessary to support a school of learning required special control and supplementary aid from the State. To this end it was the policy of colonial governments in general to protect, guide, and assist private benevolence in education. They exempted members of colleges from military duty and from taxation, and, having created colleges, freed their property from taxation and assisted them in their support by levying taxes upon the people. Thus the germs of the later educational policy were gradually developed, although the church and the State, so closely united in early education, have become almost entirely separated.

✓ If in the early records of the colonies we find that the general court has taken the initiative in founding schools, as in Maryland and Virginia, in Connecticut, Massachusetts, and New Hampshire, it must still be remembered that the "affairs of the church and the affairs of the State were subjected to the same general control,"<sup>2</sup> and consequently the early colleges "were established and supported by a two-fold agency—of the masses of the people on the one hand, and of private

<sup>1</sup> See section on "Virginia."

<sup>2</sup> C. K. Adams: Address on Washington and the Higher Education, 6.

benevolence on the other."<sup>1</sup> "It is worthy of note that the notions of the colonists were at first more or less voluntary. The church and the commonwealth were closely allied and received the benefit of the former felt it their duty to support in proportion to their means, so they were given in like manner to the maintenance of the latter."

#### GENERAL POLICY OF THE STATES

After the Declaration of Independence the provision for education assumed a more decidedly political tone. As before, to be expressed in favor of universities, created, controlled, and supported by the State. The colonies had received a new political philosophy; the ideas of sovereign States began to grow and the sense of responsibility to awaken. With this new political awakening came new views of the needs of political education for a sovereign State. The ideas already existing in favor of education for the clergy, for learning, for the social, moral, and religious improvement of the citizenry, there was added a new zeal for educated citizenship. The Constitution of 1776 provided for the establishment of more universities.<sup>2</sup> North Carolina followed the same policy by constitutional provision or by legislative enactment. The charters of the older colleges were confirmed with all their rights. In the majority of the new States, private and public education received the aid of the Legislative Assembly through grants of land, or protective laws.

The principal ways in which the several States aided higher education may be enumerated as follows: (1) by granting special privileges; (2) by freeing officers and students of colleges from military duty; (3) by exempting the persons of the officers and students from taxation; (4) by granting special grants; (5) by granting permanent money endowments; (6) by making special appropriations from funds raised by lotteries; (7) by granting the benefits of lotteries, and (8) by building buildings and sites. Nearly all of these methods originated in the colonies and were adopted by the States.

#### GRANTS AND APPROPRIATIONS.

Harvard College was aided by the first six methods mentioned above: a permanent tax endowment, and special appropriations of money; Columbia College received special grants of land; the University of Virginia received grants of land and money endowments; Georgia was one of the first States to grant

<sup>1</sup>C. K. Adams: Address on Washington and the Higher Education.

<sup>2</sup>R. T. Ely: Taxation in American States and Cities, 10

endowment; South Carolina supported her State institution by a permanent tax endowment; and Maryland granted to her first two colleges a permanent endowment supported by taxation.

Other striking examples might be cited, but it is not necessary, as these will show the general trend of legislation, and that is sufficient for our present purpose. There has been a manifest tendency in all legislation to foster learning and favor those connected with institutions of higher education, and it is no small matter that so many of the States of the Union have declared in their Constitutions for the protection and fostering care of higher education.

Nearly every State Constitution has a section relating to the encouragement of science, literature, learning, etc., and out of the thirty-eight States, two have provisions authorizing the establishment and maintenance of a State university, while twenty-four States have established universities by statute laws.

#### EXEMPTION FROM TAXATION.

One of the earliest methods of favoring colleges was the exemption of college property from taxation, which to all intents and purposes is equivalent to granting special appropriations in the several cases, equal to the amount of taxes on property of equal value. This custom was almost universal among the colonies, and even extended so far as to exempt in several instances the property of the members of the college or university. Thus, Rhode Island formerly exempted all the property of the professors of Brown University from taxation, but when the charter was revised this feature was amended, so that now the property of each professor is exempted to the extent of ten thousand dollars only. The principle of exemption of educational institutions from taxation has been so grounded in the nature of our Government as to represent a practicably irrevocable law.

Historically, no more settled and constant policy has ever been adopted by so many States in regard to higher education.<sup>1</sup> In the majority of the States either constitutional provision or statute law exempts property in actual use for educational purposes, while several go further and exempt the productive funds also. It would be difficult to estimate the number of millions of dollars thus expended during the history of our country for the support of higher learning; for it is assumed that an exception in favor of property invested in educational institutions must necessarily increase the taxes on other property, which is equivalent to voting a tax for the support of education.

According to the Report of the Commissioner of Education for the year 1885-'86, the total amount of productive funds of three hundred and forty-five colleges and universities situated in forty-three States and Territories in the United States was \$49,687,378. The total valu-

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<sup>1</sup>See Appendix A.



ation of unproductive property (college grounds, buildings, and apparatus) amounted to \$43,565,413, and the total appropriations for higher education by the several Legislatures were \$862,580. Had the unproductive funds been freed from taxation there would have been voted for higher education the additional sum of \$1,306,962. If the productive funds had been also exempted, this amount would have been increased to the sum of \$2,797,583.<sup>1</sup> Compared with the work to be done this seems but a small item of assistance, yet it means the education of some thousands of young men yearly, a constant factor in the encouragement of higher learning.<sup>2</sup> A careful consideration of this subject will show how universal has been the policy of the several commonwealths in encouraging learning in all its forms, in appreciating the necessity of advanced education, and in supplementing and encouraging private benevolence.

There is still another principle involved. The State not only recognizes the absolute necessity of superior education for the moral, social, and political well-being of its subjects, but it acknowledges that private and sectarian schools are performing work that otherwise would legitimately devolve upon the Government. To this common policy there is one exception. The comparatively new State of California, upon the principle that all property ought to be taxed, levies upon the property of institutions of learning. Having established its own university by the aid of the Federal Government, it recognizes no others as necessary to the well-being of the State, but regards them all as private business enterprises and requires them to assist in the support of the Government by direct taxation. It is a remarkable instance of the reversal of a time-honored policy which has taken deep root in the constitution of educational society. I say reversal, because soon after California became a State the Legislative Assembly granted aid to non-State institutions. An historical retrospect of the relation of the State to education may be presented in a few propositions, as follows: (1) in colonial times State, private, and church benevolence worked together; (2) subsequently private and church schools were prominent, still being aided by State appropriations; (3) the gradual cessation of State aid to private and church schools, and the growth of State universities. On the other hand, freedom from taxation continues, with more guarded provisions; the privileges of members of the non-State schools are growing less, until a State on the Pacific coast taxes education and taxes benevolence.

We may infer from the foregoing facts that there is a tendency of States, not to do *less* for higher education, but to do *more*, and to do it in a methodical way for a particular purpose. There is a wider differ-

<sup>1</sup>In every State except California the unproductive property is freed from taxation to a greater or less extent, and the productive funds of colleges are exempt in many States.

<sup>2</sup>In the same year \$1,568,433 were received from tuition fees, and from all other sources not named above the sum of \$1,739,723. The total number of students in attendance was 67,642.

entiation of State and non-State schools than formerly. There is a wider separation of church and State in matters of education. The old classical school is supported by the church, while there is a growing tendency on the part of the State to build universities for educational and industrial purposes.

The policy of early legislation is about to be realized concerning State institutions. A review of the history of the State universities, particularly of the West and South, for the past ten years will show a progressive tendency. At the present outlook it seems that there will be one well-established State institution or its *equivalent* in every State, for the promotion of those studies which pertain directly to the political and industrial sides of education. But this does not imply that non-State institutions should not receive assistance, encouragement, and protection. Every class of citizens should receive due representation, and when a very large proportion demand educational institutions constituted after their own manner of thinking, it is not only the privilege of the State to sanction by its laws the creation of such institutions, but its duty to at least see that no injustice is done, and that its attitude is in every respect encouraging. So long as these institutions make for a better citizenship, a higher learning, and a general improvement of the people, it is absolute folly for the State to tax their efforts. It is to "tax the light" and discourage private benevolence. "Nothing yields so large a return to the tax-payer as this exemption<sup>1</sup> of educational institutions from taxation.

Education is not a money-making business; it is either a benevolence or a public defence. There is not an institution of advanced learning that can pay its way by tuition. There has been a sacrifice by the people at large through the State, or by individuals, or by organizations and associations. Referring to two of the foremost political economists, Adam Smith and John Stuart Mill, we find that their doctrines oppose the practice of the taxation of institutions of learning. Adam Smith's fundamental law of taxation seems to bear directly upon the question, when it declares that "The subjects of every State ought to contribute toward the support of the government as nearly as possible in proportion to their respective abilities, that is, in proportion to the revenue which they respectively enjoy under the protection of the State."<sup>2</sup> Who ever heard of an institution of learning enjoying revenues as stock-owners in a railroad company enjoy dividends? Does any one ever hear of educational institutions of higher learning declaring dividends to individuals? Education is on an entirely different basis. When a college or a university gets money, it buys books, builds libraries, purchases apparatus, employs extra teachers, or erects a new building, that the youth of the country, the best wealth of the State, may be better fitted for the duties of citizenship and for life.

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<sup>1</sup> R. T. Ely: Taxation in American States and Cities, 345.

<sup>2</sup> Wealth of Nations, Book V, ch. 2.



Again, Mill says in reference to taxation, that "ought to be demanded from all."<sup>1</sup> Is it equality of men, by donating their means to set up a fountain in a desert, are taxed by the State for their offering to benefit a practical example, let us suppose that Mr. A. builds a library in a State university; this amount goes out of the range of taxable property and becomes an exemption, which is quite right. The tax which was hitherto on the sum must now be raised on other taxable property. On the other hand, Mr. B chooses to give \$100,000 to found a non-State institution. If this is taxed by the State, Mr. A's and Mr. B's property, devoted to the same cause, will be taxed the same way, and existing in the same form, will be taxed in an entirely different manner by the State. Mr. B's benevolence will only be taxed, but will be taxed at a higher rate than Mr. A's benevolence were taxed. In other words, Mr. B is taxed to support Mr. A's benevolence, which is not the American meaning of the term, "equality of sacrifice."

Again, it is frequently said that it would be impolitic to tax a State university, and to tax it would be the same as giving it money. It were to pass money from one hand to the other; but it is not true. The property of State universities is in part from gifts from the National Government and from private gifts from the State. The property of State universities is in part from gifts from the National Government and from private gifts from the State. The property of State universities is in part from gifts from the National Government and from private gifts from the State. In most cases a large percentage of property comes from the pockets of the people through taxation for the State to give an institution one hundred thousand dollars; then to tax the institution on this sum and two hundred thousand dollars which the State did not give, is not the same as giving it back again.

Nor is it sufficient to say, when the State has established a university, that it has provided for the support of its own university, that government has provided for higher education. To assume this is to assume that the State has provided for the needs of all classes of the population, and has placed this source of wealth at the disposal of all, and, having done this, has gone into remote places to bid young men to come, showing them the wealth of the State. The State in taking such a stand assumes an imperialism which is entirely out of place. That we need centralization is evident, but not at the expense of local institutions. Enough can not be said in favor of centralization which builds a college and invites young men to come, who would never be educated if left to the republic. A centralized institution several hundred miles from home.

Perhaps it is well to close this argument with the

<sup>1</sup> Principles of Political Economy, p. 485.

Stratton, of Mills College, who pertinently says: "Property held for private use, or for business, or on speculation, when the gain is to inure to the benefit of the holder, should be taxed; property devoted to the public good, from which the gain inures to the public at large, should not be taxed. \* \* \* Private benevolence should be allowed free scope to expand itself in these directions (*i. e.*, the welfare of the citizen and the existence of the State). \* \* \* That whenever it assumes this charge it should be regarded as the friend and ally of the State in a peculiar sense, the sharer of its cares and the bearer of its burdens."

#### NATIONAL EDUCATION ARISES FROM LOCAL.

Whatever ideas men may have had of national education, or of national aid for higher education, the precedents of the colonies and States were already established in regard to all of the points considered. Lands had been granted by the several colonies for the maintenance of schools; schools had been supported from the public treasury. But as public sentiment grew in favor of union, there was also the accompanying development of the Federal idea of education. It was observed that education was to be the nation's defence, and as such it was advocated strenuously by the greatest statesmen. The sentiments in favor of distinctly national schools were not, however, sufficiently universal to carry out any well laid plans; and Congress, although encouraging and supporting education, has thrown the chief responsibility upon the several States.

Besides the Military Academy at West Point and the Naval Academy at Annapolis, the Federal Government has managed no schools, although by libraries and museums it has added to the general sum of knowledge. The great plan has been to furnish the various States with means for the education of all within their respective domains, although many statesmen desired a more decided policy on the part of the Federal Government.

#### THE OPINIONS OF STATESMEN.

After the great struggle of the Revolution was over and the minds of men were relieved from the strain of war, and political turmoil had subsided by the organization of the new government, the fathers of the republic turned instinctively toward the moral, social, and intellectual improvement of the people. Indeed, the foundation of the new government was conditional. It was made dependent upon growing intelligence. The building of the structure whose foundation had been laid could not continue unless supported by ever increasing morality and intelligence.

One can not refer to this period of the nation's history without recognizing the profound and far reaching wisdom of George Washington on all subjects of great moment. In his first message to Congress Washington says: "Nor am I less persuaded that you will agree with

mein opinion that there is nothing more deserving your patronage than the promotion of science and literature. Knowledge in every country is the surest basis of public happiness. In one in which the measures of government receive their impressions so immediately from the sense of the community as ours it is proportionally essential."<sup>1</sup>

After reviewing the benefits to be derived from the spread of intelligence he continues, "Whether this desirable object will be best promoted by affording aid to seminaries of learning already established, by the institution of a national university, or by any other expedients, will be well worthy of a place in the deliberations of the legislature."<sup>2</sup>

Before delivering his annual message in 1796, Washington seems to have reached a more definite conclusion on the subject, for he advocates the establishment of a national university as well as a national military academy. He says: "The assembly to which I address myself is too enlightened not to be fully sensible how much a flourishing state of the arts and sciences contributes to national prosperity and reputation. True it is that our country contains many seminaries of learning highly respectable and useful; but the funds upon which they rest are too narrow to command the ablest professors in the different departments of liberal knowledge for the institution contemplated, though they would be excellent auxiliaries. Among the motives to such an institution the assimilation of principles, opinions, and manners of our countrymen by the common education of a portion of our youth from every quarter well deserves attention; the more homogenous our citizens can be made in these particulars, the greater will be our prospects of permanent union; and a primary object of such a national institution should be the education of our youth in the science of government."<sup>3</sup>

And finally, in his Farewell Address, he says: "Promote, then, as an object of primary importance, institutions for the general diffusion of knowledge. In proportion as the structure of the government gives force to public opinion, it is essential that public opinion be enlightened."<sup>4</sup>

These sentiments declared to the law-making body of the people were the expression of long-cherished desires and of deep-seated convictions. Washington's private life and correspondence show how sincerely he endeavored to realize his plans for higher education. He was opposed to sending youth abroad to secure their education, and advocated the establishment of a national university, that the youths coming from different parts of the Republic might be able to turn sectional pride into national feeling. In reference to these two ideas, and the desirability of a national university to counteract evil tendencies, he wrote in his last will and testament the following passage: "Looking anxiously forward to the accomplishment of so desirable an object as this is (in my estimation), my mind has not been able to contemplate any plan more likely to effect the measure than the establishment of a UNI-

<sup>1</sup> Sparks, XII, 9.

<sup>2</sup> *Ibid.*

<sup>3</sup> Sparks, XII, 71.

<sup>4</sup> *Ibid.*, 227.

VERSITY in a central part of the United States, to which the youths of fortune and talent from all parts thereof may be sent for the completion of their education in all the branches of polite literature, in arts and sciences, in acquiring knowledge of the principles of politics and good government, and, as a matter of infinite importance, in my judgment, by associating with each other and forming friendships in juvenile years, be enabled to free themselves in a proper degree from those local prejudices and habitual jealousies which have just been mentioned, and which, when carried to excess, are never-failing sources of disquietude to the public mind and pregnant of mischievous consequences to this country."<sup>1</sup> In the same document Washington bequeathed fifty shares of stock held in the Potomac Company<sup>2</sup> "toward the endowment of a university to be established within the limits of the District of Columbia under the auspices of the General Government, if that Government should incline to extend a fostering hand toward it."<sup>3</sup> But as the Government took no energetic action in the matter nothing ever came of the wise benevolence of the far-seeing statesman except the inheritance by posterity of sound educational ideas which will certainly in due time receive their full and merited appreciation.

In his private correspondence Washington often returns to the above views, always emphasizing three points, viz: (1) the education of youth at home rather than abroad; (2) the removal of local prejudices, and (3) the promotion of political intelligence as a national safeguard. These points are strongly urged in his letter to Governor Brooke, of Virginia.<sup>4</sup> In his correspondence with Adams, Hamilton, and Jefferson he is no less pronounced in favor of a national university; but with clear discernment he rejects the Jeffersonian scheme of transplanting the Geneva University bodily to America.<sup>5</sup> He desired an American university for Americans. "The Father of his Country wished to save

<sup>1</sup> Quoted by Dr. H. B. Adams, *College of William and Mary*, 43; Sparks, XI, 4.

<sup>2</sup> Adams: *College of William and Mary*, 44.

<sup>3</sup> The Legislature of Virginia, as a mark of esteem and acknowledgment of the great services of General Washington to the State and to the Federal Government, gave him one hundred shares of James River improvement stock and fifty shares of Potomac stock. He declined to accept the gift, but offered to direct it into channels of public use if so desired. Consequently the donation was withdrawn by an act of the Legislature, and the property was placed at the disposal of Washington, to be devoted to whatsoever public object he might direct. (Hening, *Statutes*, XII, 44.) Washington, after due consideration, concluded that the entire Potomac stock should be devoted to one object—the prospective university in the Federal City, but he left the disposal of the James River stock to the Legislature of Virginia, and that body decided in favor of endowing a seminary within the State. It was given to Liberty Hall Academy, afterward Washington Academy and Washington College, now Washington and Lee University. (Sparks, IX, 83, 142.)

<sup>4</sup> Adams: *College of William and Mary*, 43.

<sup>5</sup> Letter to John Adams, November, 1794; Sparks, XI, 1. For a full discussion of this subject, see *College of William and Mary*, 46, 47.



the United States on the one hand from provincialism and on the other from sectionalism," and in accomplishing these ends he considered national aid to education necessary.

Previous to the bold declarations of Washington on national education, two statesmen had taken a firm position in favor of a national university in their deliberations as members of the Constitutional Convention in 1787, over which Washington presided. These were Charles Pinckney, of South Carolina, and James Madison, of Virginia. On the 29th of May the former offered to the Convention a plan for a Federal Constitution, which, among other powers of Congress, authorized it "to establish and provide for a national university at the seat of government of the United States."<sup>1</sup> His plan was not accepted, and in the discussion of the Randolph constitution, Mr. Pinckney, followed by Mr. Madison, moved, on the 14th of September, to insert in the list of powers vested in Congress a power "to establish an university in which no preferences or distinctions should be allowed on account of religion."<sup>2</sup> Mr. Wilson supported the motion, but Gouverneur Morris said, "It is not necessary. The exclusive power at the seat of government will reach the object."<sup>3</sup>

The matter was dropped on the ground that Congress already had sufficient power to enact laws for the support of national education. But the discussion doubtless had its influence upon the members of the Convention, and the presiding officer certainly was in sympathy with the movement; for, fresh from the discussions in the Convention, he presented the recommendations of 1790, hitherto mentioned, to Congress. James Madison, when in the presidential chair, did not forget his earlier zeal for science. In his second annual message he reverted to his favorite idea of a national university: "Whilst it is universally admitted that a well instructed people alone can be permanently a free people, and while it is evident that the means of diffusing and improving useful knowledge form so small a proportion of the expenditures for national purposes, I can not presume it to be unreasonable to invite your attention to the advantages of superadding to the means of education provided by the several States a seminary of learning instituted by the national legislature, within the limits of their exclusive jurisdiction, the expense of which might be defrayed or re-imbursed out of the vacant grounds which have accrued to the nation within those limits."<sup>4</sup>

The sentiments of John Adams were expressed at every opportunity in favor of universal intelligence. He wrote to the educational committee of Kentucky as follows: "The wisdom and generosity of the Leg-

<sup>1</sup> Madison Papers, II, 740.

<sup>2</sup> Madison Papers, III, 1577. Mr. Madison had previously moved to place among the powers of Congress a power "to establish an university." (Madison Papers, III, 1354.)

<sup>3</sup> *Ibid.*

<sup>4</sup> Annals of Congress, 1810-11, 13.

islature in making liberal appropriations in money for the benefit of schools, academies, and colleges, is an equal honor to them and their constituents, and a proof of their veneration for letters and science, and a portent of great and lasting good to North and South America, and to the world."<sup>1</sup>

The efforts of Thomas Jefferson in behalf of universal education in Virginia are well known, and the eminent success of the University of Virginia is a living testimony of his great service to his State and country.<sup>2</sup>

Though not so pronounced in favor of national aid as of State aid to education as some of his contemporaries, yet in the development of the University of Virginia he has performed a national service, in the general influence of that great institution on higher education, particularly in the southern portion of the United States. In his sixth annual message to Congress, referring to the tariff on imports, Jefferson declared in favor of Federal aid to education in the following words: "Shall we suppress the impost and give that advantage to foreign over domestic manufactures? On a few articles of more general and necessary use the suppression in due season will doubtless be right, but the great mass of the articles on which impost is paid is foreign luxuries, purchased by those only who are rich enough to afford themselves the use of them. Their patriotism would certainly prefer its continuance and application to the great purposes of the public education, roads, rivers, and canals."<sup>3</sup> \* \* \*

The chief service of Jefferson to education was rendered in remodeling the curriculum of William and Mary College and in founding a "university of character in his own State."

James Monroe was very pronounced in favor of the promotion of intelligence by wise legislative measures, and so expressed himself at different times to Congress.

John Quincy Adams in his first annual message, after referring to some of the powers of the Constitution, thus represents the obligation of the Government concerning education and internal improvement: "If these powers and others enumerated in the Constitution may be effectually brought into action by laws promoting the improvement of agriculture, commerce, and manufactures, the cultivation of the mechanic and of the elegant arts, the advancement of literature, and the progress of the sciences, ornamental and profound, to refrain from exercising them for the benefit of the people themselves would be to hide in the earth the talent committed to our charge, would be treachery to the most sacred of trusts."<sup>4</sup>

These opinions of the early fathers of the Republic concerning the education of the people clearly represent it as a national trust.

<sup>1</sup> Report of the Commissioner of Education, 1867-68, 320.

<sup>2</sup> Adams: Thomas Jefferson and the University of Virginia.

<sup>3</sup> Works of Thomas Jefferson, VIII, 68.

<sup>4</sup> Congressional Debates, 1825-26, Appendix, p. 8.



Although the early plans for national university education have not yet been realized, Congress has continued to favor from time to time the cause of education by grants and appropriations intrusting to the several States the responsibility of the education of youth. While the greater effort has been put forth in favor of "common public schools," much has been done to forward and support higher education. There always have been, and are now, many statesmen with a large following who adhere to the principle laid down by Thomas Jefferson, that the university is as much a public trust as is the primary school.

During the last fifty years, since the benefits of the Ordinance of 1787 have been more fully realized, and since the results of the Congressional grant of 1862 have begun to be seen, there has been an upward tendency of State education, and in many sections a growing antagonism (entirely uncalled for) between State and non-State institutions. The author of this sketch may be pardoned if, without entering fully into the discussion of this subject, he refers to it in such a manner as to show the progress of educational ideas.

Edward Everett, in his oration on "Aid to the Colleges," says: "But, sir, we are still told \* \* \* that common school education is a popular interest, and college education is not; and that for this reason the State is bound to take care of the one and not of the other. Now, I shall not put myself in the false and invidious position of contrasting them; there is no contrast between them, no incompatibility of the one with the other. Both are good; each is good in its place; and I will thank any person who can do so to draw the line between them; to show why it is expedient and beneficial in a community to make public provision for teaching the elements of learning, and not expedient nor beneficial to make similar provision to aid the learner's progress toward the mastery of the most difficult branches of science and the choicest refinements of literature. \* \* \*

"As far as individuals, many or few, are concerned, I have just as much natural right to call on the State to pay the bill of the tailor who clothes, or the builder who shelters, my children, as of the school-master or school-mistress, the tutor or professor, who instructs them. The duty of educating the people rests on great public grounds, on moral and political foundations. \* \* \*

"We enter not into particulars; we do not presume to suggest a limit to your liberality, or to dictate the form it shall assume. But we do with some confidence call upon you to recognize and act upon the principle that the encouragement of academic education is one of the great interests of the State. We do ask you to reject the narrow, and, as we think, the pernicious doctrine, that the colleges are not, equally with the schools, entitled to your fostering care. This, sir, is not Massachusetts doctrine. It is not the doctrine of the Pilgrims. This Commonwealth was founded by college-bred men, and before their feet had well laid hold of the pathless wilderness they took order for founding an institution like those in which they had themselves been

trained, the universities of Cambridge and Oxford, in England. \* \* \* Amid all the popular susceptibilities of the day it never entered into their imaginations that academic education, less than school education, was the interest of the entire people."<sup>1</sup>

#### RECENT DISCUSSION PERTAINING TO STATE AND NATIONAL EDUCATION.

In a very able address, delivered in 1873, President Eliot,<sup>2</sup> of Harvard University, took strong grounds against State support to higher education. He held that the State might provide for universal elementary education on the ground that it was a cheap system of police for the national defence, but that no man ought to be taxed to send another man's son to the high school or college.

On the other hand, ex-President White, of Cornell University, one of the foremost champions of State education, in answer to the above argument has formulated the following propositions:<sup>3</sup> "The main provision for advanced education in the United States must be made by the people at large acting through their legislatures to endow and maintain institutions for the higher instruction, fully equipped and free from sectarian control. I argue, first, that the past history and present condition of the higher education in the United States raises a strong presumption in favor of making it a matter for public civil action, rather than leaving it mainly to the prevailing system of sectarian development."—"I argue, next, that careful public provision by the people for their own system of advanced instruction is the only republican and the only democratic method."—"Again, I argue that public provision, that is, the decision and provision by each generation as to its own advanced education, is alone worthy of our dignity as citizens."—"Again, I argue that by public provision can private gifts be best stimulated."—"I argue, next, that by liberal public grants alone can our private endowment be wisely directed or economically aggregated."—"But I argue, next, that our existing public school system leads logically and necessarily to the endowment of advanced instruction."—"Again, I argue that the existing system of public endowments for advanced education in matters relating to the military and naval service leads logically to public provision for advanced education in matters relating to the civil service of the nation."—"Again, I argue that not only does a due regard for the material prosperity of the nation demand a more regular and thorough public provision for advanced education, but that our highest political interests demand it."—"And, finally, I

<sup>1</sup> Everett's Orations and Speeches, II, 618, 623, 625.

<sup>2</sup> See paper read before the higher department of the National Educational Association at Elmira, N. Y., August 5, 1873, by President Eliot, and a review of the same by John W. Hoyt, chairman of the National University committee of the above Association.

<sup>3</sup> "National and State Governments and Advanced Education;" Am. Jour. of Soc. Sci., No. 7, 1874, 302-11.



insist that it is a duty of society to itself, a duty in itself, a duty which it cannot throw off, to see that the stock of talent of each generation shall have opportunity for development and that it may increase the world's stock and aid in the world.

Granted that it is the duty of the State to maintain superior instruction, there is no reason why the institution should be private benefaction, as the so-called sectarian schools are antagonized. The duty of the State is no less plain in the maintenance and protection of the latter, than in the creation and maintenance of the former. And, on the other hand, it is just as idle for independent and denominational colleges to combine against a State as it is for the centralizing power of the university to ignore the existence or the great service of the colleges. Mr. Mill has said that "all education should be in the hands of a centralized authority, composed of clergy or of philosophers, and be, consequently, on the same model and directed to the perpetuation of a state of things which, instead of becoming more acceptable, would be more repugnant to mankind, with every step taken in the unfettered exercise of their highest faculties."<sup>2</sup> I doubt this assertion, and it might be applied to the State.

No doubt we need centralization in education to-day in anything else, but we do not need imperialism. Mr. Mill has said of the function of the State in education, but at the same time that "one thing must be strenuously insisted on; that the State must claim no monopoly for its education, either in the higher branches."<sup>3</sup> Though localism and diverse organizations have been brought into existence many institutions which, perhaps, would have better been combined into one, offering superior instruction; yet these same local institutions have educated scores of men and women in the neighborhood, who otherwise would have gone their way into a large centralized university. Facts show that we have none too much of the higher education in the field. The State should send no burdens are laid upon educational institutions supporting any class of citizens.

It is estimated that in 1840 the proportion of college-bred to the entire population in the United States was 1 to 1,540; in 1870, 1 to 2,546; in 1880, 1 to 1,840; and in 1886, 1 to 1,400. Making all our combined efforts in favor of higher education, we are far short of some of the countries of the Old World. "The people," says President C. K. Adams, "know that one of the universities of Great Britain has recently completed a coat of arms at a cost of more than £500,000 (\$2,430,000)—not to mention the millions that were put into the Polytechnicum at Charl-

<sup>1</sup> This quotation represents only an outline of the argument.

<sup>2</sup> Cf. *Positive Philosophy* of Auguste Comte, 92.

<sup>3</sup> *Political Economy*, book V, chapter XI, § 2.

many have had their attention called to the fact that the little republic of Switzerland, with a territory not a third as large as the State of New York, has recently from its public treasury built a chemical laboratory for the Polytechnic School at Zurich at a cost of 1,337,000 francs (\$267,400), and that it has more recently contracted for the building of a physical laboratory at a cost of 994,000 francs! And of those who suppose that needless sums are expended by Harvard, Yale, and Cornell, how many know that the little Kingdom of Saxony, only half as large as Vermont, gives from its public treasury annually \$400,000 to its university, although the institution itself has great wealth and the professors are supported mainly by the fees of students? Let us indulge in no extravagances and no illusions; let us realize that we are young and vigorous, and that we are growing at a rapid rate; but let us not cherish the erroneous supposition that there is a single well-endowed university in America. Let us remember that the richest of our institutions has an income not much larger than that of a single one of the twenty-four colleges at Oxford. Above all, let us never forget that so long as it is necessary for our institutions to depend upon the fees of students, it will be impossible for them to put themselves into the condition of real universities. Until individual endowments are in one way or another very largely increased, the greater part of the work of education must be of the rank of preparatory schools; and consequently, until that day arrives, our young men will continue to flock to Germany for the completion of their training."

This statement ends with the old complaint of Washington, uttered a hundred years ago—the need of a great university that would suffice to educate young men on this side of the Atlantic and a central institution which would create homogeneity of sentiment. Whether these great ideals are ever to be realized or not, it is highly proper that the States and the nation see to the education of their own citizens. The great universities of England, though largely supported by private endowments, are national in their life, and are rapidly returning to the interests of the masses of the people. It would be impossible to estimate the influence that these universities have had on the British Government.

Although American colleges and universities have not universally exercised such a direct influence upon national affairs, indirectly their usefulness has been immeasurably great,<sup>1</sup> while from colonial times they have ever been near to the masses of the people.

<sup>1</sup>Thirty-nine of the fifty-six signers of the Declaration of Independence were college-bred men; the percentage of known college graduates in three Congresses is: Fortieth, Senate, 47; House, 32; Forty-first, Senate, 46; House, 31; Forty-second, Senate, 46; House, 32. In other offices we find that the percentage of college graduates is as follows: Presidents, 65; Secretaries of War, 61; Postmaster-Generals, 53; Vice-Presidents, 50; Secretaries of the Navy, 47; Speakers of the House, 61; Secretaries of State, 65; Secretaries of the Interior, 50; Associate Judges of the Supreme Court, 73; Secretaries of the Treasury, 48; Attorney-Generals, 53; Chief Justices of the Supreme Court, 83.

## THE ORIGIN OF THE GRANT.

The origin of this gift must be sought in local communities. In this country all ideas of national education have arisen from those States that have felt the need of local institutions for the education of youth. In certain sections of the Union, particularly the North and West, where agriculture was one of the chief industries, it was felt that the old classical schools were not broad enough to cover all the wants of education represented by growing industries. There was consequently a revulsion from these schools toward the industrial and practical side of education.

Evidences of this movement are seen in the attempts in different States to found agricultural, technical, and industrial schools.

These ideas found their way into Congress, and a bill was introduced in 1858, which provided for the endowment of colleges for the teaching of agriculture and the mechanical arts. The bill was introduced by Hon. Justin S. Morrill, of Vermont; it was passed by a small majority, and was vetoed by President Buchanan. In 1862 the bill was again presented with slight changes, passed and signed, and became a law July 2, 1862.

## PROVISIONS OF THE GRANT.

Without giving the entire text of this familiar act, a few of its main provisions will be mentioned. It stipulated to grant to each State thirty thousand acres of land for each Senator and Representative in Congress to which the States were respectively entitled by the census of 1860, for the purpose of endowing "at least one college where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the Legislatures of the States may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life." It is to be noticed that the main requirement is to teach such *branches of learning as are related to agriculture and the mechanic arts*, and that, this being accomplished, such other studies as were thought proper could be introduced. Secondly, the defence of the nation was provided for by the suggestion concerning military tactics and the subsequent act pertaining thereto. Again, the "liberal" as well as the "practical" education of the industrial classes was sought after. And, finally, the youth were to be fitted for "pursuits and professions of life."

From this proposition all sorts of schools sprang up, according to the local conception of the law and local demands. It was thought by some that boys were to be taught agriculture by working on a farm, and practical agricultural schools were founded with the mechanical arts attached. In other States classical schools of the stereotyped order were established with more or less science; and, again, the endowment in others was

voted to scientific departments. The instruction of the farm and the teaching of pure agriculture have not succeeded in general, while the schools that have made prominent those studies relating to agriculture and the mechanic arts, upon the whole, have succeeded best.

Among the conditions of this grant it was imperative that no mineral lands should be "selected or purchased," and that if there was not sufficient public land in a given State, scrip should be issued for the actual number of acres to which the State was entitled, and this land scrip could be sold, the purchaser being allowed to locate it in any of the States where there was sufficient land entered at one dollar and twenty-five cents or less per acre.

In several instances the managers of the land scrip have understood that by this provision the State could not locate the land within the borders of another State, but its assignees could thus locate lands, not more than one million acres in any one State. By considering this question, the New York land scrip was bought by Ezra Cornell, and located by him for the college in valuable lands in the State of Wisconsin, and thus the fund was augmented.

However, the majority of the States sold their land at a sacrifice, frequently for less than half its value. There was a lull in the land market during the Civil War, and this cause, together with the lack of attention in many States, sacrificed the gift of the Federal Government. The sales ranged all the way from fifty cents to seven dollars per acre, as the average price for each State.

It was further enacted that the proceeds should be preserved entire, as a permanent fund, and that the income derived from it was to be used in the support and maintenance of the college. It could not be used in the erection of buildings or otherwise diminished, except that ten per centum of the fund might be used for the purchase of sites or experimental farms, if so ordered by the Legislature of the State. In addition to this, it was provided that if any portion of the invested fund or interest thereon "shall, by any action or contingency, be lost, it shall be replaced by the State to which it belongs."

#### NATURE OF THE ACT PROVIDING FOR AGRICULTURAL AND MECHANICAL SCHOOLS.

It is to be observed by the tenor of this act that the Federal Government intended the grant should form a nucleus in each of the several States, around which buildings, libraries, laboratories, workshops, gymnasiums, lecture halls, and other educational appliances should be grouped, by means of private munificence and State bounty. It was to prove a stimulus to the generosity of the people and the liberality of the States.

To this test the people, through private gifts, and municipal and State governments, have responded, with few exceptions, in a liberal way. Thirty-seven of these colleges formed under the land-scrip act

the question of the establishment of a seminary of national legislature. The committee reported unfavorable and unconstitutional for the Government to found, endow, proposed seminary.<sup>1</sup>

In 1816 another committee was appointed to consider the subject, and again the scheme failed.<sup>2</sup> From this time the subject seemed practically settled, and we hear little more of it in the circles until the discussion of the disposal of the Smithsonian fund toward the founding of a national university. The subject at this time received free discussion, and it was in the defeat of the university plan. While the plan for a national university has not yet succeeded, Congress has established the National Museum, the Congressional Library, the National Observatory,<sup>3</sup> and the Bureau of Education, for the promotion of art and science.

An attempt to found a national university was made after the circulation of the reports of the Paris Exposition.

The comparative results of the Exposition were the cause of the revival of the old university idea. The Exposition showed to the commissioners, that the poorly-endowed American universities compared very unfavorably with the well-endowed, fully-equipped European universities. The subject was aroused, and there was a determination on the part of the commissioners to build a great American university equal those of Europe.

Others besides the commissioners felt the need of a national university of this nature. Dr. Thomas Hill, on retiring from Harvard University, said that "a true American university is a national work like that of Cornell and other universities, and the free discussion of the subject showed a dissatisfaction in the condition of affairs at the present time."

Commissioner John W. Hoyt reported on the Paris Exposition to Congress, in part, as follows: "To tell the plain truth, that our many universities are but sorry skeletons of the well-shaped institutions they ought to be, and must become, and are fairly entitled to rank among the foremost universities of the present day. And if we are not always to suffer the contempt of European scholars, who properly enough regard us as a clever but uncultured people, it is time that all true lovers of learning should be awake to the importance of at once providing the means for a more liberal and higher culture in every department of knowledge."

<sup>1</sup> Ex. Doc., 11th Congress, 3d session.

<sup>2</sup> Ex. Doc., 14th Congress, 2d session.

<sup>3</sup> The National Naval Observatory now stands on "University Square," fixed upon by Washington for the national university.

Let us have, without further delay, at least one real university on the American Continent."<sup>1</sup>

In 1873 Mr. Hoyt was a member of the Congressional committee appointed to report on a national university. The committee, after considering the conditions of education in America and the endowments of colleges, reported the following reasons why a national university should be founded, viz: (1) That none has, or is likely to have for a century to come, resources essential to the highest and most complete university work. (2) That none can be made so entirely free from objection on both denominational and local grounds as to insure the patronage of the people regardless of sectional or partisan relation. (3) That no institution not established on neutral ground, or other than national in the important sense of being established by the people of the whole nation and in part by a national end, could possibly meet all of the essential demands made upon it."

<sup>2</sup>The bill reported at this time provided for a university at the capital, endowed by the Federal Government to the amount of twenty million dollars, yielding 5 per cent interest; the income to be used for buildings, furnishings, and for the general support of the university. It is hardly necessary to state that the bill did not pass.

It is not intended to discuss the question of a national university, but attention should be called to the great changes that have taken place in higher education in the last fifteen years.

The old colleges have broadened their courses and increased their endowments. State universities have come into power during this period, and the agricultural colleges, many of them then begun, have developed into flourishing institutions of learning. There has arisen a new class of universities, created by heavy private endowments; such are Johns Hopkins, Cornell, Tulane, Clark, Boston, Stanford, and others. With these new additions and the progress of the old schools, many of the evils complained of in the above report have disappeared. Whether these new institutions, working with the old, will fill the national demands for education, and thus render a national university unnecessary remains to be seen. It is evident that it is not an easy task to create a national university.

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<sup>1</sup> Report on Education, U. S. Commission, Paris Exposition, VI. John W. Hoyt deserves great credit for his observations of higher education abroad.

<sup>2</sup> House Report No. 89, 42d Congress, third session, I, 96.

of rotative cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manures, natural or artificial, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may be in each case deemed advisable, having due regard for the varying conditions or needs of the respective States and Territories.

"SEC. 4. That for the purpose of paying the necessary expenses of conducting investigations and experiments and printing and distributing the result as hereinbefore prescribed, the sum of \$15,000 is hereby appropriated to each State, to be especially provided for by Congress in the appropriations from year to year, etc."

In 1887 twenty-two colleges of agriculture and the mechanic arts report themselves as sustaining relations to State agricultural stations. These colleges have taken or doubtless will take advantage of this act.

#### SPECIAL GRANTS AND APPROPRIATIONS.

The Government has made from time to time certain small grants for specific purposes for the aid of education.

The following list is taken in part from the Report of the Commissioner of Education for 1876. It is evident that several of these items should not be counted as applying to the support of higher education, but they are given here as a matter of interest and as exceptions to general custom or policy of the Government in aiding miscellaneous institutions:

|                                                                                              | Amount |
|----------------------------------------------------------------------------------------------|--------|
| ALABAMA—Lafayette Academy .....                                                              | 400    |
| FLORIDA—Chattahoochee Arsenal, buildings, land, etc., to the State .....                     |        |
| GEORGIA—Dalton Arsenal, grounds, buildings, to Agricultural College .....                    | 10     |
| KENTUCKY—Center College (originally to deaf and dumb asylum) .....                           | 23,400 |
| LOUISIANA—Pine Grove Academy (quitclaim by United States) .....                              | 4,000  |
| MISSISSIPPI—Jefferson College, lot at Natchez .....                                          | 30     |
| TENNESSEE—Fisk University, land and buildings .....                                          | 3      |
| WEST VIRGINIA—Storer College, four lots and buildings at Harper's Ferry .....                |        |
| MISSOURI—Certain lots, commons, etc., confirmed to towns for the purposes of education ..... | 1,400  |
| DAKOTA—Holy Cross Mission .....                                                              | 100    |
| CONNECTICUT—Asylum for the education of the deaf and dumb .....                              | 23,000 |
| MICHIGAN—Saint Ste. Marie .....                                                              | 1      |
| Mackinac, lot and building .....                                                             |        |
| MINNESOTA—Domestic and Foreign Missionary Society of the Protestant Episcopal Church .....   | 9      |

\* Report of the Commissioner of Education, 1886-87, p. 707.

† Acts of Congress, 1812, 1824, and 1831.

‡ Not considered in the range of this paper.

In this classification it is shown that 51,651.01 acres have been granted, aside from those lots whose areas have not been determined. Out of this number at least 26,963.25 acres have been devoted to the cause of higher education.

Tennessee also received, in 1806, a special grant of one hundred thousand acres of land, fifty thousand for each of two colleges, one to be located in East and one in West Tennessee.<sup>1</sup> At the same time an additional one hundred thousand acres were granted for the support of academies, one in each county.

#### GRANTS OF THE PROCEEDS OF THE SALE OF PUBLIC LANDS.

Many special grants of certain percentages of the proceeds of the sales of public lands were made by Congress to the several States. These percentages varied with each grant, the Government following a general policy rather than any specific act. Ohio received the first grant, consisting of three per cent. of the sales of land, to be laid out in building highways. Each of the States from this time on, with the exception of Maine, Texas, and West Virginia,<sup>2</sup> received either three or five per cent. of said sales. The grants were devoted to purposes of internal improvement or to education, according to the terms of the contract.

Illinois, by an act of April 18, 1818, specified that one-sixth of the sums derived from this source should be exclusively bestowed on a college or university. From 1821 to 1869 Illinois received the amount of \$713,445.75. The whole amount received by the several States as percentages on land sales (to 1876) is \$6,508,819.11. Of this sum it is estimated that \$2,997,234.35 have been devoted to education, but it is impossible to determine what part of this fund has been used in the support of *higher* education. Illinois, Wisconsin, Iowa, Florida, Oregon, Kansas, Nebraska, Missouri, Arkansas, and Nevada have applied the proceeds of the percentages to the support of education. In 1841 ten per cent. of the proceeds of the sales of public lands within their respective borders were granted to the following States without specification regarding the disposal of the same, viz.: Ohio, Illinois, Alabama, Missouri, Mississippi, Louisiana, Arkansas, and Michigan.<sup>3</sup>

#### SALINE AND SWAMP LANDS.<sup>4</sup>

An act was passed September 28, 1850, granting to the several States the disposal of certain swamp lands, after being redeemed by the States. It was intended that these lands should pay for the construc-

<sup>1</sup> U. S. Statutes at Large, V, 433.

<sup>2</sup> These States had no public lands within their borders.

<sup>3</sup> U. S. Statutes at Large, V, 433.

<sup>4</sup> See Appendix B.

Revised Statutes of United States, sections 2479-90.



call of General Putnam and General Tupper, to consider the question of occupying "the Ohio." At this meeting the Ohio company was formed, for the purpose of settling the said territory by soldiers of the Revolutionary War. A memorial was presented to Congress, which led to the reference of the subject to a committee, which reported a new bill differing from the plan referred to them. The committee in their report wished to reserve one section in each township for common schools, one for the support of religion, and four townships for the support of a university.<sup>1</sup> Congress thought these concessions to this company too liberal, and desired to hold to the ordinance of 1785, which provided for the reservation of one section only for common schools. This was unsatisfactory to the company, whose case was managed by Dr. Manasseh Cutler, and a compromise was effected, by which Congress reserved one section for the support of religion, one for common schools, and two townships for the support of a "literary institution, to be applied to the intended object by the legislature of the State."<sup>2</sup> The bill became a law on the 13th of July, and is now commonly known as the "ordinance of 1787 for the government of the North-West Territory."

Of the six articles of compact which form a part of the Ordinance, the third is remarkable as indicating the future policy of the Federal Government and the several States. The oft-quoted passage is referred to which declares that "religion, morality, and knowledge being necessary to good government and the happiness of mankind, schools and the means of education shall forever be encouraged."<sup>3</sup>

This Ordinance was immediately followed by a contract with the Ohio Company, which fulfilled the conditions of the land grant and insured to the State of Ohio two townships of land for the support of a university.<sup>4</sup>

#### THE JOHN CLEVES SYMMES PURCHASE.

In the same year (1787) John Cleves Symmes formed a company for settlement in the North-West Territory, and contracted with the board of treasury for a large tract of land. The land was purchased on nearly the same conditions as that obtained by the Ohio Company; the reservations for common schools and for the ministry were similar, but only one township was granted for a university.<sup>5</sup> Thus Ohio received three townships of land for the support of advanced learning.

No general law was passed by Congress concerning the granting of land for seminaries of learning, but the precedent of the celebrated Ordinance of 1787 became a national policy. After the year 1800 each

<sup>1</sup> Bancroft, II, III.

<sup>2</sup> Bancroft, II, 433, appendix.

<sup>3</sup> Ford, Constitutions and Charters, 429.

<sup>4</sup> These two townships were given to endow the State University at Athens, and the Ohio University.

<sup>5</sup> This township was used to endow Miami University.

State admitted into the Union, with the exceptions of Maine, Texas, and West Virginia, received two or more townships of land for the purpose of founding a university.

This national educational policy was inaugurated almost by accident. Congress was very desirous of disposing of the lands and to turn them to financial account at once. On the other hand, there were a few men like Pickering, Putnam, and Cutler, who were intensely earnest on the subject of education, and doubtless there was a majority of the members of Congress who favored the plan on account of its educational policy as well as the means which it afforded of facilitating the disposal of the public lands; but no one at that time could apprehend the far-reaching results of such a measure. And, as the matter stood, it is doubtful whether such a measure would have been carried in Congress at that time on the basis of national aid to education alone.<sup>1</sup> Nevertheless it was a great measure, and if all were not fully alive to its importance as an educational movement, let us remember that the Constitution of the United States was at this period undergoing a narrow escape from defeat by those who did not understand its greatness.

#### OPINION OF DANIEL WEBSTER.

Daniel Webster recognized the greatness of the Ordinance when he said:<sup>2</sup> "I doubt whether one single law of any lawgiver, ancient or modern, has produced effects of more distinct, marked, and lasting character than the Ordinance of 1787." And again: "It set forth and declared it to be a high and binding duty of Government to support schools and advance the means of education."<sup>3</sup>

#### EXTENSION OF THE PRIVILEGES OF THE ORDINANCE OF 1787.

In 1803 Congress extended the privileges of the Ordinance of 1787 to the States in the Mississippi territory, granting the sixteenth section of every township for the purposes of common-school education, and one entire township for the support of a seminary of learning.<sup>4</sup> In 1806, by a special act of Congress, one hundred thousand acres were granted to Tennessee for two colleges, one to be established in East and one in West Tennessee, and one hundred thousand acres to establish an academy in each county. Thus, through the national policy inaugurated in 1787, 1,082,880 acres of land have been granted for seminaries of learning in the United States. The actual results of this grant will be discussed in connection with the policy of each separate State. It is

<sup>1</sup> *U. S. R.*, p. 17.

<sup>2</sup> *Works of Webster*, III, 103.

<sup>3</sup> *See Webster*, p. 13.

<sup>4</sup> Each of the States each received at least two townships. Ohio, Florida, Georgia, and Minnesota received, respectively, 62,120, 92,120, 92,120, and 52,040 acres.

sufficient to say at this point that the Ordinance has b  
of creating many of the foremost universities in the Uni

#### DISTRIBUTION OF THE SURPLUS REVENUE IN

Under an act<sup>1</sup> of Congress passed in 1836, the surplus i  
treasury on hand at the beginning of the next year was  
distributed, after deducting the sum of five million doll  
several States according to their respective numbers of R  
in Congress. The money was to be distributed in four i  
during the year 1837. The States were to bind themselv  
the money when called upon, provided that not more than  
dollars be demanded at any one time from a single State  
days' notice, and that all States were to be called upo  
time for their pro rata.<sup>2</sup>

This can be called an educational measure on the part  
Government only in so far as it presented opportunities  
to use the funds for the promotion of education, and as su  
of notice. As far as the National Government was conc  
aim was financial and not educational. It was desired  
surplus revenue which had accumulated by means of  
land sales and revenues arising from a protective tariff.<sup>3</sup>  
in introducing the measure made a long and able arg  
port of the bill, in which he estimated that at the begin  
1837 there would be at least forty million dollars of surpl  
ury, and it was supposed at the beginning of the distri  
amount to be thus disposed of would be \$37,468,859.47.  
three quarterly instalments exhausted the Treasury,  
consequently only the amount of \$28,101,645 paid t  
States.

Mr. Murray, secretary of the board of regents, has pr  
showing the amounts given to each State, and the purp  
was devoted.<sup>4</sup> The table will be given here, although i  
the amounts devoted to the support of higher education.  
can be ascertained it will be given in the discussion o  
States.

<sup>1</sup> See Appendix B.

<sup>2</sup> U. S. Statutes at Large, V, 55.

<sup>3</sup> This fund has been held by the several States subject to cal  
Government. During the late war New York signified her readine  
obligations.

<sup>4</sup> Webster's works, IV, 252.

<sup>5</sup> Historical Records, 91.

<sup>6</sup> New York devoted the whole amount to education, and as i  
interest of \$235,000 the total income and its interest amount, fo  
to about eleven million dollars.

|                      | No.<br>elect-<br>ors. | Amount<br>received. | Objects to which applied.                         |
|----------------------|-----------------------|---------------------|---------------------------------------------------|
| Alabama .....        | 7                     | \$669,086.78        | Education.                                        |
| Arkansas .....       | 3                     | 286,751.48          | General purposes.                                 |
| Connecticut .....    | 8                     | 764,679.61          | Education one half, general purposes one-half.    |
| Delaware .....       | 3                     | 286,751.48          | Education.                                        |
| Florida .....        |                       |                     |                                                   |
| Georgia .....        | 11                    | 1,051,422.09        | One third education, two thirds general purposes. |
| Illinois .....       | 5                     | 477,919.13          | Education and internal improvements.              |
| Indiana .....        | 9                     | 869,254.44          | One half education, one half general purposes.    |
| Kentucky .....       | 15                    | 1,433,757.40        | Education.                                        |
| Louisiana .....      | 5                     | 477,919.13          | General purposes.                                 |
| Maine .....          | 10                    | 955,838.27          | General purposes.                                 |
| Massachusetts .....  | 14                    | 1,348,173.57        | General purposes.                                 |
| Maryland .....       | 10                    | 955,838.27          | Education and general purposes.                   |
| Mississippi .....    | 4                     | 382,335.31          | General purposes.                                 |
| Missouri .....       | 4                     | 382,335.31          | Education.                                        |
| Michigan .....       | 3                     | 286,751.48          | Internal improvements.                            |
| New Hampshire .....  | 7                     | 669,086.78          | General purposes.                                 |
| New Jersey .....     | 8                     | 764,679.61          | General purposes.                                 |
| New York .....       | 42                    | 4,014,529.71        | Education.                                        |
| North Carolina ..... | 15                    | 1,433,757.40        | Education in part, internal improvements.         |
| Ohio .....           | 21                    | 2,007,269.36        | Education.                                        |
| Pennsylvania .....   | 39                    | 2,867,514.89        | Education in part.                                |
| Rhode Island .....   | 4                     | 382,335.31          | Education.                                        |
| South Carolina ..... | 11                    | 1,051,422.09        | Education one-third, general purposes two-thirds. |
| Tennessee .....      | 15                    | 1,433,757.40        | General purposes.                                 |
| Vermont .....        | 7                     | 669,086.78          | Education.                                        |
| Virginia .....       | 23                    | 2,198,428.04        | General purposes.                                 |

#### LAND GRANT FOR COLLEGES OF AGRICULTURE AND THE MECHANIC ARTS.

Next to the Ordinance of 1787, the Congressional grant of 1862 is the most important educational enactment in America.

Though less than a quarter of a century has elapsed since the acceptance of this gift by the majority of the States, far-reaching results have already been attained from this well-timed donation. With proper treatment the donation itself was a magnificent aid for the actual support of higher learning; but its chief excellence consists in the stimulation which it gave to State and local enterprise. By this gift forty-eight colleges and universities have received aid, at least to the extent of the Congressional grant; thirty three of these, at least, have been called into existence by means of this act. In thirteen States the proceeds of the land scrip were devoted to institutions already in existence. The amount received from the sales of land scrip from twenty-four of these States aggregates the sum of \$13,930,156, with land remaining unsold estimated at nearly two millions of dollars. These same institutions have received State endowments amounting to over eight million dollars.

## THE ORIGIN OF THE GRANT.

The origin of this gift must be sought in local communities. In all parts of the country all ideas of national education have arisen from local conditions that have felt the need of local institutions for the education of the people. In certain sections of the Union, particularly the North, where agriculture was one of the chief industries, it was found that the old classical schools were not broad enough to cover all the education represented by growing industries. There was a revulsion from these schools toward the industrial and practical education.

Evidences of this movement are seen in the attempt of the States to found agricultural, technical, and industrial schools.

These ideas found their way into Congress, and a bill was passed in 1858, which provided for the endowment of colleges for the education of agriculture and the mechanical arts. The bill was introduced by Hon. Justin S. Morrill, of Vermont; it was passed by a majority of 100, and was vetoed by President Buchanan. In 1862 the bill was re-introduced with slight changes, passed and signed, and became the Morrill Act of 1862.

## PROVISIONS OF THE GRANT.

Without giving the entire text of this familiar act, a few of its provisions will be mentioned. It stipulated that to each State should be granted ten thousand acres of land for each Senator and Representative to which the States were respectively entitled by the census of 1850, for the purpose of endowing "at least one college where the land shall be, without excluding other scientific and classical studies, including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the legislatures of the States may respectively prescribe, in order to promote the liberal and practical education of the industrial classes of the people in the pursuits and professions of life." It is to be noticed that the requirement is to teach such *branches of learning as are related to agriculture and the mechanic arts*, and that, this being accomplished, other studies as were thought proper could be introduced. The defence of the nation was provided for by the suggestion of military tactics and the subsequent act pertaining thereto. The "liberal" as well as the "practical" education of the people was sought after. And, finally, the youth were to be educated in the "pursuits and professions of life."

From this proposition all sorts of schools sprang up, according to the local conception of the law and local demands. It was thought that boys were to be taught agriculture by working on a farm. Agricultural schools were founded with the mechanical arts. In other States classical schools of the stereotyped order were continued with more or less science; and, again, the endowment in o

learned of the art of navigation. Experience and observation were their tutors. In 1802 the Naval Regulations provided "school-masters" who should diligently and faithfully instruct the midshipmen in those sciences appertaining to their department. This provision proved of little consequence, however, since no new officers were created, but the duties of the "school-master" were simply laid upon the chaplain, who of the whole ship's crew probably knew the least about navigation. This defective system continued in force with but slight alteration for many years.

Different Secretaries of the Navy during the period down till 1845 urged upon Congress the necessity of establishing a naval academy for the systematic instruction of midshipmen upon land; but nothing came of these appeals more than the establishment of the office of school-master as distinct from that of chaplain, and some slight changes in the qualifications and duties of midshipmen and instructors. During this period, however, different Secretaries of the Navy, with the tacit approval of Congress, had established several small naval schools at suitable ports for the instruction of midshipmen off regular duty, and had yearly turned over part of the regular Navy appropriation to their support.

#### FOUNDATION AND GROWTH.

The United States Naval Academy was opened October 10, 1845.<sup>1</sup> The credit of its foundation is attributed to Hon. George Bancroft, who was then Secretary of the Navy. When Mr. Bancroft entered his office as Secretary there were in existence four small naval schools, one at New York, one at Philadelphia, one at Boston, and one at Norfolk. These schools were designed for the instruction of midshipmen when not engaged in other duties. At this time there were in the service for the instruction of midshipmen twenty professors and teachers, fourteen of whom were at sea and the others stationed at the naval school. The yearly cost of maintaining this force was \$28,200.<sup>2</sup> This sum was not, however, directly appropriated by Congress for this purpose, but it was the custom to take this amount from the regular appropriations to the Navy.

The weakness of this system is evident. Its force was not concentrated, but was spread out in fragments at navy-yards and in cruising-ships. This was seen by Secretary Bancroft, and he at once set about to remedy it. He found the means already at hand for accomplishing his purpose. By placing a number of the professors on waiting orders, and by concentrating a few of the best professors in one place, a naval academy was established, and a large amount of the sum which was previously expended in instruction, necessarily inefficient, in small and unorganized schools, was centered upon one independent organization.

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<sup>1</sup>Annual Register of United States Naval Academy, 1874.

<sup>2</sup>Seely: History of the Naval Academy, 39.

The place chosen as that most suitable for the Naval Academy was Fort Severn, an old army post, the site of which had been bought by the Government in 1808, at a time when Annapolis was considered a point of military importance. Upon application by the Secretary of the Navy this post was transferred from the War to the Navy Department. Commander Franklin Buchanan, of the United States Navy, was appointed Superintendent of the Academy, and at once drew up rules and regulations for its government.

The course of instruction embraced six departments, viz, naval tactics and practical seamanship, mathematics, natural and experimental philosophy, gunnery and infantry tactics, ethics, and modern languages.<sup>1</sup>

The number of students enrolled during the first year was one hundred and one, ninety-one of whom were seniors.

In July, 1850, new regulations for the government of the Academy were prepared. The main features of the change were the extension of the course of study, and in the requirements for admission. Up to 1850 the course of instruction occupied five years, of which three were passed at sea. In 1850 it was made seven years, four in 1851, and six, the last two of which were to be spent at sea, in 1873, where it now remains.<sup>2</sup>

On account of the Civil War then in progress the Naval Academy was removed to Newport, R. I., in May, 1861, but re-established at Annapolis in 1865, at the close of the strife.

The number of naval cadets allowed to enter the Naval Academy is one for each Member or Delegate of the House of Representatives, appointed at his recommendation, one from the District of Columbia, and ten appointed at large by the President. The number of appointments that can be made is limited to twenty-five each year, named by the Secretary of the Navy after competitive examinations, the cadets being fourteen to eighteen years old. The pay of the naval cadet is five hundred dollars a year. The course of instruction, as remodelled and improved, is thorough, involving a close pursuit of mathematics, steam-engineering, physics, mechanics, seamanship, ordnance, history, law, etc.

#### **APPROPRIATIONS FOR SUPPORT.**

It seems from an examination of the records of that time that, during the first three years after the establishment of the Academy, no extra appropriations were made for its support by Congress other than the sum of twenty-eight thousand two hundred dollars regularly set aside for the salaries of professors and teachers under the old system 1848, however, Congress appropriated nineteen thousand three hundred and eighty dollars for repairs and improvements, in addition

<sup>1</sup> Soley, 91.

<sup>2</sup> Annual Register, 1884, Introduction.

the regular sum; and from this time on regular yearly sums were granted for support and improvements.

The following year, 1849, the generous appropriation of \$218,200 was made for the support of the Academy. The largest appropriation made by Congress was \$358,400, in 1866. This was for the purpose of purchasing additional grounds and erecting new buildings at the close of the War. The appropriation from that year on was gradually lessened until 1869-70, when it was \$182,500. The appropriation for the sixteen years following this date averaged \$175,000 a year. The total general appropriation made by Congress for the support of the Naval Academy, down to the year 1886, inclusive, amounted to over five million dollars.

#### THE LIBRARY.

Soon after the establishment of this school in 1845, the Navy Department transferred to it a number of books which had been in use in the navy-yards and men-of-war. This formed the nucleus of the present library. Since 1852 additions have been constantly made by allowing a yearly sum out of the congressional appropriations for contingent expenses of the Naval Academy.

The increase in the library by decades has been as follows: December 31, 1855, 4,751 volumes; December 31, 1865, 9,593 volumes; December 31, 1875, 17,678 volumes.<sup>1</sup>

The total amount expended upon the library is estimated at \$35,180.<sup>2</sup>

#### THE UNITED STATES NAVAL OBSERVATORY.

The United States Naval Observatory, though not situated at Annapolis, will be considered under this head, on account of its close co-operation with the Naval Academy. The object of its establishment was to encourage scientific pursuits in lines that would especially benefit commerce and navigation. As early as 1810 Congress was memorialized to establish a national observatory, the object urged at the time being the location of a first meridian in the United States. This petition was followed by numerous others; but nothing tangible was secured until 1830, when a bureau for the care of instruments and charts of the Navy was established through the influence of Lieut. L. M. Goldsborough. In 1833 Lieutenant Goldsborough was succeeded by Lieutenant Meeks, of the United States Navy, who erected at his own expense an observatory sixteen feet square.

A bill was passed by Congress, approved August 31, 1842, authorizing the Secretary of the Navy to contract for the building of a house for the charts and instruments of the Navy on a plan not exceeding in cost twenty thousand dollars. In June, 1871, Congress authorized

<sup>1</sup> See *History of the Naval Academy*, 135.

<sup>2</sup> *Ibid.*, 136.



the superintendent of the observatory to contract for a large refractor at a cost not exceeding fifty thousand dollars. In the following year Congress appropriated fifty thousand dollars for this purpose, and one hundred thousand dollars more for the erection of a tower and dome for this instrument.

Regular sums were set apart out of the Navy appropriation from time to time for the support of the Naval Observatory. In 1860, \$59,360<sup>1</sup> were granted for its support; \$65,900<sup>2</sup> in 1871 (these estimates include the expenses in getting out the Nautical Almanac for these years); and in 1880, \$22,500<sup>3</sup> (for observatory alone).

Along with the observatory has grown up a special library, partly through gifts and donations and partly through appropriations. In 1881 the observatory library numbered eighty-five thousand volumes.

#### THE LIBRARY OF CONGRESS.

##### EARLY HISTORY OF THE LIBRARY.

The National Library, or Library of Congress, was established in 1800, a short time before the seat of government was changed to Washington. It had its origin in the needs and demand of Congress for books and information. Previous to 1800, when the National Legislature assembled at Philadelphia, it had no library of its own, but was dependent upon private libraries of the different members and the gratuitous use of books tendered by the Library Company of Philadelphia.

The first appropriation made by Congress for the purchase of books was on the 24th of April, 1800. Under "An act to make further provisions for the removal and accommodation of the Government of the United States"<sup>4</sup> the sum of five thousand dollars was appropriated for the purchase of such books as might be necessary for the use of Congress at the city of Washington, and for fitting up a suitable apartment for containing them and placing them therein.<sup>5</sup> The books, pamphlets, maps, etc., purchased in pursuance of this act form the nucleus of the Congressional Library.

A report<sup>6</sup> submitted to the House December 21, 1801, by John Randolph, of Virginia, chairman of the committee appointed to take into consideration the care of books, formed the basis of the first systematic statute organizing the Library of Congress. This act<sup>7</sup> located the Library of Congress, created the office of librarian, and vested his appointment in the President of the United States, placed the regulation of the library under the supervision of the President of the Senate and Speaker of the House, and further, regulated the taking of a

<sup>1</sup> See Ex. Doc. for 1860.

<sup>2</sup> *Ibid.*, 1-71.

<sup>3</sup> *Ibid.*, 13-1.

<sup>4</sup> Laws of United States, V, 376.

<sup>5</sup> American State Papers, Miscellaneous, I,

<sup>6</sup> *Ibid.*

In the same year (1783) Colonel Bland moved to accept the Virginia proposition as offered, and that the lands be divided into districts, in which the Continental soldiers were to receive bounty lands. The income of one-tenth of the territory was to be devoted to "the payment of the civil list of the United States, the erecting of frontier forts, the *founding of seminaries of learning*, the surplus, if any, to be appropriated to the building and equipping of a navy.<sup>1</sup> The resolution was referred to a committee, and never came up again.

#### THE VIRGINIA CESSION.

The Virginia cession was accepted by Congress with modifications, and there was guaranteed to the State sufficient land in reservation to pay off her obligations promised to her soldiers in the war.

On the first day of March, 1784, the date of the acceptance of the Virginia cession, Thomas Jefferson offered a plan for the temporary government of the Northwest Territory, in which no mention was made of provisions for *seminaries of learning* nor even *for education in any form*. The plan was accepted with amendments, yet without mention of education. In the following month Thomas Jefferson brought forward a plan for the survey and sale of the lands in question, which was indefinitely postponed by Congress. In 1785 it was again brought up and referred to a committee. This plan contained no mention of the "provision made for ministers of the gospel, nor *even for schools and academies*."<sup>2</sup>

The committee reported a new ordinance containing many propositions of the old, and in addition provided that "There shall be reserved the central section of every township for the *maintenance of public schools*, and the section immediately adjoining for the support of religion."<sup>3</sup>

For over a month the ordinance was debated before Congress, and the clause on religion was omitted and many other amendments made before its final adoption on the 20th of May, 1785. There was no mention of seminary grants in the ordinance, but the clause reserving "from sale lot number sixteen of every township for the maintenance of public schools within the township,"<sup>4</sup> marks the commencement of the policy since uniformly observed in the reservation of one section in each township of each State for the support of common schools.<sup>5</sup>

#### THE OHIO COMPANY.

The petition of the New England officers of the army having failed, a body of citizens met on the 1st day of March, 1786, in Boston, at the

<sup>1</sup> Bancroft, History of the Constitution, I, 312.

<sup>2</sup> Life of Jefferson, 2, I, 579. King to Pickering.

<sup>3</sup> Journals of Congress, IV, 500.

<sup>4</sup> *Ibid.*, 521.

<sup>5</sup> In the case of Oregon and all States admitted thereafter, two sections were granted for the support of common schools.

By the copyright law of March 3, 1865, one copy (later two) of each publication for which the Government grants a copyright is required to be deposited in the Library of Congress. By an act of Congress approved July 8, 1870, the entire registry of copyrights within the United States, which was previously scattered all over the country in the offices of the clerks of the United States district courts, was transferred to the Library of Congress. The advantage gained by this change was important. It secured the advantage of one central office, where all works published throughout the country could be found; and besides, from this time on the copyright fees were paid into the treasury instead of being absorbed, as they formerly were, by the clerical expenses of the offices of the district courts. Thus by this latter means a considerable sum is saved each year to the Library for the purchase of books and other regular expenses. Some idea of the addition of books to the Library by means of the copyright system, as well as the income through copyright fees, may be received from the following table:

*Increase of Library of Congress through copyright law.<sup>1</sup>*

| Year.      | Books deposited through copyright law. | Copyright fees. | Year.      | Books deposited through copyright law. | Copyright fees. |
|------------|----------------------------------------|-----------------|------------|----------------------------------------|-----------------|
| 1870 ..... | 5,600                                  | \$4,748         | 1875 ..... | 15,927                                 | \$13,151        |
| 1871 ..... | 12,688                                 | 10,187          | 1876 ..... | 14,882                                 | 12,500          |
| 1872 ..... | 14,164                                 | 12,283          | 1877 ..... | 15,758                                 | 13,020          |
| 1873 ..... | 15,352                                 | 13,404          | 1878 ..... | 15,798                                 | 13,134          |
| 1874 ..... | 16,243                                 | 13,524          | 1879 ..... | 18,125                                 | 14,680          |

#### LAW LIBRARY.

The Law Library of Congress, though located in a different room, is under the charge of the Librarian of Congress and subject substantially to the same regulations as the general Library. This Library numbered thirty-five thousand volumes in 1876.

#### GROWTH OF LIBRARY.

During the period 1860-'84 the Library of Congress has increased more than eightfold. In 1860 it contained 63,000 volumes; in 1866, 100,000; in 1872, 246,000; in 1878, 374,022; and in 1884, 513,441.<sup>2</sup>

#### THE NATIONAL MUSEUM AND SMITHSONIAN INSTITUTION.

There is perhaps no more striking example of the encouragement learning by a state than that presented by the history of the Nation

<sup>1</sup> Librarian's Reports in Senate documents, 1870-'79.

<sup>2</sup> Librarian's reports.

Museum at Washington. In giving assistance to this *generally* known though not *well* known institution, the Government has aided the cause of education and the spreading of universal knowledge in a most catholic manner.

#### THE IMPORTANCE OF MUSEUMS IN EDUCATION.

As the late Prof. Joseph Henry well remarked, "there is scarcely any subject connected with science and education to which more attention is given at the present day than that of collections of objects of nature and art known under the general denomination of museums. This arises from their growing importance as aids to scientific investigation and instruction."<sup>1</sup>

It is generally conceded that the primary object of a museum is to furnish scholars with materials with which to work; but the Museum at Washington has been a means of instruction to the people at large and a great national educator. It has not only furnished the means for the "increase and diffusion of knowledge among men" as individuals, but it has been the strong support and ally of learned societies, the example and pattern to museums throughout the several States and foreign countries, and, through the Smithsonian agency, a promoter of knowledge throughout the world.<sup>2</sup> One can not come from a visit to the average college or university museum where objects are buried, or where the museum has been a receptacle for all sorts of unclassified material which found little place elsewhere, and enter the National Museum without being impressed with a new idea of the true use of a museum. It is more than a storehouse; it is learning illustrated and classified; or, to use Professor Goode's definition, "a museum is a carefully selected series of labels, each illustrated by a specimen." Under the influence of such ideas as this and the liberal views of men like Professors Henry, Baird, and Langley, the museums throughout the country are beginning to have a new appearance and effect a new work.

Great as has been the work of the National Museum already, its opportunities at the present and for the future in forwarding the interests of education are being multiplied each day. While scientific research continues, while public lectures are given, while the system of exchanges goes on, and questions are answered citizens throughout the United States, from three hundred to three hundred and fifty thou-

<sup>1</sup> Smithsonian Report, 1879, *Ibid.*, 1886, 5.

<sup>2</sup> "Not only are collections sent to other institutions for study, but there are always from ten to twenty students at work in the building availing themselves of the hospitalities of the establishment. At present the entire natural history collections of the National Museum of Mexico are here under the charge of two principal naturalists of that country." Dr. G. Brown Goode in *The Chautauquan*, 1885. A suggestive article by Dr. Goode on "Museum History and Museums of History," appears in the *Papers of the American Historical Association*, vol. iii, 497-519.

sand persons visit the museum each year. The great majority of these come to see the curiosities. Some go away impressed with the vastness of what they saw, having a confused panorama of the whole collection, with a certain half-knowledge about a great many things which renders them no service as a means of education. Others come for a special purpose, remaining one or more days or weeks to study particular things in special departments.

While the highest interests of scientific research must be subserved, the diffusion of knowledge from the stand-point of general education might be greatly increased. Some subjects bearing upon ancient and modern society, archaeology, anthropology, ethnology, history, economics, industries, and arts could possibly be so handled as to make a more direct impression upon the intelligent public, and, while thus giving actual instruction to thousands, furnish a lesson and an example to all State, college, and university museums in the country. But before proceeding further with the discussion let us ascertain what has already been done.

#### HISTORY OF THE SMITHSONIAN INSTITUTION.

The existence of the Museum is so closely connected with that of the Smithsonian that a review of the more important historical events of the latter is necessary to a full understanding of the former.

#### THE BEQUEST OF JAMES SMITHSON.

As is perhaps well known, the original source of the foundation of the Smithsonian was the bequest of James Smithson, an English scientist, who, in his will of October 23, 1826, left all of his property "to the United States of America . . . to found at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge among men."<sup>1</sup>

James Smithson was a gentleman of good family, who devoted his life chiefly to study and scientific writing, particularly in the lines of geology, mineralogy, and chemistry; and coupled with a love of science was a desire to perpetuate his name through his works. He says: "The best blood of England flows in my veins; on my father's side I am a Northumberland; on my mother's I am related to kings; but this avails me not. My name shall live in the memory of man when the titles of the Northumberlands and the Percys are extinct and forgotten."<sup>2</sup> Such was the sentiment of a man who chose to bestow upon a young and growing nation his private fortune, to be used for the benefit of mankind.

Prof. W. R. Johnson, in speaking of Smithson, has characterized

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<sup>1</sup>Facsimile copy of the will of James Smithson, found in *Rhees's Smithsonian and Bequest*, 24; an exception was made of an annuity of one hundred pounds to J. F. *Rhees*, 2.

spirit of the foremost men in connection with the Institution since its foundation. He says: "The man of science is willing to rest on the basis of his own labors alone for his credit with mankind and his fame with future generations. In the view of such a man, the accidents of birth, of fortune, of local habitation, and conventional rank in the artificial organization of society, all sink into insignificance by the side of a single truth of nature. If he have contributed his mite to the increase of knowledge; if he *have diffused that knowledge* for the benefit of man, and, above all, if he have applied it to the useful or even to the ornamental purposes of life, he has laid, not his family, not his country, but the world of mankind under a lasting obligation."<sup>1</sup>

The United States Government accepted the gift, and appropriated ten thousand dollars to carry the case through the courts of chancery.<sup>2</sup>

After all expenses were deducted, the net proceeds of the bequest were paid over to the treasury in Philadelphia, to the amount of \$508,318.46. This sum was increased by interest, until a statement, made August 10, 1846, exhibits the sum of \$773,753.07 in the fund and its accumulations.<sup>3</sup> Out of this fund the building was erected, and other expenses reduced it to \$515,109.

In 1867 the Secretary of the Treasury was authorized to receive a residuary legacy of Smithson amounting to \$26,210.63, on the same conditions as the original bequest. The fund was also increased by savings and by two private bequests, one by James Hamilton, in 1874, of one thousand dollars, and the other by Simon Habel, in 1880, of five hundred dollars. The total permanent fund in the Treasury of the United States bearing six per cent. interest at present amounts to \$703,000.<sup>4</sup>

#### THE FEDERAL GOVERNMENT BECOMES GUARDIAN TO THE BEQUEST.

The Federal Government thus became the guardian of this bequest, being limited in carrying out the plans of the giver by these words, "the increase and the diffusion of knowledge among men." Although under the direction of the Government, it has ever exercised a wholesome neutrality, never becoming involved in the toils of practical politics.

Professor Langley says in a recent report as secretary of the Smithsonian, "The position of the Smithsonian is that of a ward of the Government, having property of its own, for which that Government acts the part of trustee, while leaving its administration wholly with the regents; in other words, that the Institution enjoys a measure of inde-

<sup>1</sup> *Ibid.*, p. 10.

<sup>2</sup> *Ibid.*, p. 11.

<sup>3</sup> *Smithsonian Report*, 1846-47, p. 55, 6.

<sup>4</sup> *Smithsonian Report*, 1887-88, Report, No. II, 758.

<sup>5</sup> *Smithsonian Report*, 1887-88, 7.

pendence, and in it a power of initiative good which ought to be deemed its most privileged possession; so that any action which is taken by one having its interests at heart ought to be with this consideration of its independence always in mind."<sup>1</sup> Much earlier Professor Henry advanced a similar idea when he said: "That the Institution is not a national establishment, in the sense in which institutions dependent on the Government for support are so, must be evident when it is recollected that the money was not absolutely given to the United States, but intrusted to it for a special object."<sup>2</sup> However, since the establishment of the National Museum in connection with the Smithsonian Institution, which is supported by an increasing annual appropriation, the Government has been drawn continually closer to the Institution, though the constitution and powers of the regents will doubtless lift it above any possible baneful influence of partisanship.

After the acceptance of the bequest, the question of deciding in what manner the terms of the will could best be complied with and what direction the proposed new institution should take, arose and produced a long discussion. Martin Van Buren, then President of the United States, through the Secretary of State, Mr. Rush, addressed a communication to prominent men, soliciting their opinions in regard to the best method of disposing of the funds.<sup>3</sup> The replies were various, and in some instances plans were exceedingly diverse.

Thomas Cooper, of South Carolina, thought that a national university should be located at Washington, with studies of a practical tendency, and open only to the graduates of colleges in the United States.<sup>4</sup> He would exclude ethics and politics, and lay great stress upon mathematics, chemistry, botany, etc. Had he advocated the former, he would doubtless have followed the opinions of the illustrious father of our country. Francis Wayland, of Brown University, also recommended a university. "Its object would be to carry forward a classical and philosophical education beyond the point at which a college now leaves it, and to give instruction in the broad and philosophical principles of a professional education."<sup>5</sup>

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<sup>1</sup> Report for 1857-'58, 2.

<sup>2</sup> Smith. Mis. Coll., XVII, 949.

<sup>3</sup> *Ibid.*, 837.

<sup>4</sup> *Ibid.*, 838.

<sup>5</sup> *Ibid.*, 839.

<sup>6</sup> *Ibid.*, 849.

observatory, a favorite theme with him.<sup>1</sup> "But the great object of my solicitude," he continues, "would be to guard against the cancer of almost all charitable foundations—jobbing for parasites, and sops for hungry incapacity."

Many other opinions were given, more or less remarkable, but want of space will not permit their repetition here. It is sufficient to say that none of the plans were accepted, although they had influence in determining the disposal of the bequest. The idea of a university was defeated by the arguments of Rufus Choate and others, on the ground of its "narrow utilitarianism." The subject of organization was brought up again and again before any conclusion as to the disposal of the bequest could be made. The present plan was finally wrought out of many, through a compromise, Mr. Choate breaking down all opposition in favor of universities by his masterly oratory.

#### ORGANIZATION OF THE INSTITUTION.

An organization was finally effected, and the funds made subject to the control of a board of regents. The institution is placed under the control of a board consisting of the President of the United States and his cabinet, the Commissioner of Patents, and a board of regents, comprising the Vice-President of the United States, the Chief Justice of the Supreme Court, three members appointed from the Senate, three from the House, and six other persons not members of Congress, two of whom must be residents of Washington.<sup>2</sup> This represents the present organization, slight changes having been made from the original plan.

Professor Henry, in the Secretary's first annual report, submitted a programme of organization of the Smithsonian Institution, which was adopted by the board of regents December 13, 1847, and has since become the settled policy of the institution, with the exception of slight changes by resolutions adopted in 1855. The programme provided for a museum, a library, and a gallery of art, with a building to contain them.

From the will of Smithson the following outline was deduced as a plan of organization: *To increase knowledge*: It is proposed (1) to stimulate men of talent to make original researches by offering suitable rewards for memoirs containing new truths; and (2) to appropriate annually a portion of the income for particular researches under the direction of suitable persons.

*To diffuse knowledge*: It is proposed (1) to publish a series of periodical reports on the progress of the different branches of knowledge; and (2) to publish occasionally separate treatises on subjects of general interest.

<sup>1</sup> In his first inaugural message John Quincy Adams recommended an appropriation by Congress for the establishment of an astronomical observatory. The proposition was received with applause.

<sup>2</sup> Report for 1855, 4.



These main propositions were further analyzed and specified. The secretary is now made responsible to Congress, and reports directly to that body rather than to the board of regents.

#### THE NATIONAL MUSEUM.

It is through this institution that the Government has performed its chief service to the cause of universal knowledge. The National Museum is at present under the direction of the regents of the Smithsonian. The nucleus was formed in 1846, under the title of the "National Cabinet of Curiosities," the specimens being stored at that time in the Patent Office building. Eleven years after the specimens were placed under the charge of the Smithsonian Institution; their custody was accepted by the regents on the condition that sufficient yearly appropriations should be made by Congress for their proper care. Since then materials have increased rapidly from year to year, and have been collected chiefly from the following sources.<sup>1</sup>

(1) "Natural history and anthropological collections accumulated since 1850 by the efforts of the officers and correspondents of the Smithsonian Institution.

(2) "The collection of the Wilkes exploring expedition, the Perry expedition to Japan, and other naval expeditions.

(3) "Collections of the scientific officers of the Pacific Railroad Survey, the Mexican Boundary Survey, and the surveys carried on by the Engineer Corps of the Army.

(4) "The collections of the United States Geological Surveys, under the directions of the United States geologists, Hayden, King, and Powell.

(5) "The collections of the United States Fish Commission.

(6) "Gifts by foreign governments to the Museum, or to the President and other public officers of the United States, who are forbidden by law to retain such gifts in their private possession.

(7) "The collections made by the United States to illustrate the animal and mineral resources, the fisheries, and the ethnology of the native races of the country, on the occasion of the International Exhibition in 1876, and the fishery collections displayed by the United States in the International Exposition, at Berlin in 1880, and at London in 1883.

(8) "The collections given by foreign governments of the several foreign nations, thirty in number, which participated in the exhibition at Philadelphia.

(9) "The industrial collections given by numerous manufacturing and commercial houses of Europe and America, at the time of the Philadelphia exposition and subsequently.

(10) "The material received in exchanges for duplicate specimens from the museums of Europe and America at the time of the Philadelphia exhibition and subsequently."

<sup>1</sup> Report for 1875, II, 1 et seq. Report of Dr. Goode.

These are the principal sources, and are given here to show the vast amount of material that may be used to illustrate science and promote education. The increase of the number of collections made it necessary for Congress to make a large appropriation in 1877 for the purpose of constructing the present museum building. Congress appropriated two hundred and fifty thousand dollars, which was subsequently increased to \$315,400 by special appropriations for furnishings, etc. A study of the building and its appointments would convince the most skeptical person that here is an instance of the economical use of public funds for the aid of knowledge unparalleled in history. Prior to the erection of this building (1880), the total number of groups of specimens received was 8,475; since its erection more than twelve thousand groups have been added.

It appears from a recent report of the Secretary<sup>1</sup> that there were on hand at the close of the year 1888 specimens or lots of specimens numbering two million eight hundred thousand.

Congress has gradually increased the appropriations for the care of the museum from four thousand dollars in 1857 to ten thousand dollars in 1870, and the last appropriation in 1888 amounted to \$220,000, and the Secretary's estimate for 1889 reached the sum of \$279,500 for all expenses.

#### EDUCATIONAL WORK.

Dr. Goode, in his address before the American Historical Association in Washington, in December, 1888, emphasized the importance of the educational advantages offered by the Museum. "He thinks that the Museum is largely educational. By using books, pictures, casts, maps, and personal relics for illustrative purposes, the friends of history in America can greatly stimulate popular interest in the development of human culture and modern civilization."<sup>2</sup> "The National Museum is already beginning to illustrate the origin and growth of music, the highest of all arts. The history of the ways and means of transportation, simple as the idea now seems, covers the entire range of man's economic development, from the rude devices of the savage to the modern applications of steam and electricity by civilized man. As a practical means of quickening popular interest in the historical side of the National Museum, it was suggested that a national portrait gallery be developed in Washington, with pictures of early discoverers, colonial founders, pioneers, governors, statesmen, and public men, grouped, when possible, by States."

Free access to the collections has been given to students in the various branches of natural history, and instruction has been given to

<sup>1</sup> Report to Congress, December 1, 1888, p. 10.

<sup>2</sup> Abstract in *Annals of the D. P. Academy*. See *Reports of American Historical Association*, volume, for 1888, p. 10. *For a complete report*.

<sup>3</sup> Abstract in *Annals of the D. P. Academy*.

a few persons in taxidermy and photography. The latter has been done at the request of the executive department, as the students have rendered service in return for the instruction given.

Gifts and loans of photographs and working drawings of the Museum cases, specimens and copies of Museum labels have been made to other public institutions.

This represents the true national idea in education—to aid by its superior methods all other institutions of similar character throughout the wide realm of States. To this end the National Museum should be a model institution in every respect. Material aid has also been given by the distribution of two hundred and sixty-four lots of specimens to museums, colleges, and individuals. Professor Langley, in his last report, says: "The importance of museum collections for the purposes of education in schools is becoming of late years much more fully appreciated, and it seems desirable to make some changes in the manner of distributing specimens, especially to make the collections sent out so complete—within such limits as it may be possible to develop them by methods of arrangement and labels—that they may be ready for immediate use in instruction."<sup>1</sup>

#### LEARNED SOCIETIES.

The National Museum endeavors to co-operate with all learned societies which place themselves in an attitude to render co-operation possible.

The annual meeting of the National Academy of Sciences was held in the Museum building; a course of Saturday lectures, twelve in number, was given in the lecture-room; and four lectures were given by the Amateur Botanical Club of Washington in the same room. The Biological Society of Washington and the Botanical Branch of the same held some of their meetings in the building. There is a growing tendency toward co-operation of the different scientific institutions in the United States with the work at the Museum.

During the past year the American Historical Association was chartered by Congress, and an intimate connection was established between the Association and the Institution. As the passage of this bill of incorporation marks a new development, and presages a new use of the historical resources of the Museum, it is quoted here:

*"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That Andrew D. White, of Ithaca, in the State of New York; George Bancroft, of Washington, in the District of Columbia; Justin Winsor, of Cambridge, in the State of Massachusetts; William F. Poole, of Chicago, in the State of Illinois; Herbert B. Adams, of Baltimore, in the State of Maryland; Clarence W. Bowen, of Brooklyn, in the State of New York, th*

<sup>1</sup> Report of Secretary for 1888, 55.

sociates and successors, are hereby created in the District of Columbia a body corporate and politic, by the name of the American Historical Association, for the promotion of historical studies, the collection and preservation of historical manuscripts, and for kindred purposes in the interest of American history and of history in America. Said association is authorized to hold real and personal estate in the District of Columbia so far only as may be necessary to its lawful ends to an amount not exceeding five hundred thousand dollars, to adopt a constitution, and to make by-laws not inconsistent with law. Said association shall have its principal office at Washington, in the District of Columbia, and may hold its annual meetings in such places as the said incorporators shall determine. Said association shall report annually to the secretary of the Smithsonian Institution concerning its proceedings and the condition of historical study in America. Said secretary shall communicate to Congress the whole of such reports, or such portion thereof as he shall see fit. The regents of the Smithsonian Institution are authorized to permit said association to deposit its collections, manuscripts, books, pamphlets, and other material for history in the Smithsonian Institution or in the National Museum; at their discretion, upon such conditions and under such rules as they shall prescribe.

"Approved, January 4, 1889."

This association should aim to connect itself with all State institutions of a similar nature in the country, and thus begin a systematic and practical use of the Museum. On the other hand there is ample opportunity to develop a department of modern as well as ancient history in the Museum. How this is to be done depends upon the association and the authorities of the Museum. But from this central body might go out to libraries, and schools, and lecture bureaus, and to historical societies, copies of manuscripts, photographs, and bulletin plates for lecturers throughout the country.

Possibly there could be established at Washington a central lecture course on history, which includes in these days anthropology, ethnology, geography, and economics, and by means of photographs and plates such lectures could be given elsewhere, until there would be a united body of historians all over the land studying from a common center, after an organized plan, and continually contributing to the increase and enlargement of knowledge among men."

It would seem desirable for the association to establish relations with local and State historical societies for the purpose of cooperation in research, the collection of materials, and the diffusion of historical knowledge. The secretary of the Smithsonian was one of a committee of three appointed by Congress to form a commission on historical manuscripts.

With regard to forming a valuable collection of historical archives, family papers, valuable letters, and historical autographs might be made.

Professor Cochrane's idea that the chief value of a museum is educa-

tional applies to every department of knowledge that can be illustrated by a specimen or picture; and in this department, as in others, the possibility of an intelligent use of museums is slowly dawning upon teachers. A dingy room filled with unclassified material will soon be an indication that there are other fossils filling professors' chairs.

The present use of the American Museum of Natural History, in Central Park, New York, for the systematic instruction of professional teachers is a commendable illustration of progress in this line. A regular course of lectures is formed, which are delivered in regular order on Saturdays, in a small hall prepared for the work, with a seating capacity of 275 persons. The trustees hired Chickering Hall for the benefit of the autumn course (1887). The average number attending was 1,329. Besides the use of materials for illustration, stereopticon slides are used to reproduce non-portable materials.

The State has indorsed the work by a liberal appropriation for carrying it on.

#### PUBLIC LECTURES.

One of the early plans was to have in connection with the Museum a course of lectures, more or less popular in their nature. The board of regents accordingly authorized a system of free lectures in the Smithsonian Institution. The first lectures were delivered in 1848, there being devoted to this purpose the sum of eighty dollars. The amounts appropriated for lectures increased from year to year, together with the incidentals connected with illustrating lectures, the greatest appropriation reaching the sum of \$1,044.32, in the year 1863. In 1865 the lecture courses were suspended for a term of five years, being resumed in 1870, and suspended again in 1876. From 1848 to 1876 lectures were continued through twenty-four years, during which time there was appropriated for this purpose out of the Smithsonian fund the total sum of \$21,701.28.<sup>1</sup> The lectures at present held in the hall of the Museum have been under the auspices of the learned societies, though of a somewhat miscellaneous and popular nature. These were largely attended. Many of the lectures had direct reference to the work of the Museum, and were illustrated by specimens.<sup>2</sup>

#### PUBLICATIONS AND EXCHANGES.

"The diffusion of knowledge among men" has been effected in different ways by the Institution, but chiefly through publications and exchanges. The principal publications are of five series, as follows:<sup>3</sup> (1) Contributions to knowledge; (2) Miscellaneous collections; (3) Annual report of the board of regents to Congress; (4) The proceedings of the National Museum; and (5) Annual reports of the Bureau of Ethnology.

<sup>1</sup> Smith. Mus. Coll., XVIII, 729.

<sup>2</sup> G. Brown Goode, Report for 1885, 21.

<sup>3</sup> Secretary's Report for 1888, 21 *et seq.*

The first series was commenced in 1848, and now numbers twenty-five volumes, composed of valuable papers of scientific research. The second series was commenced in 1862; though of less scientific importance than the first, it has increased far more rapidly, its published volumes now numbering thirty-three. The foregoing publications have been made at the expense of the Smithsonian income on permanent funds, while the remaining three series have been published at the expense of the Government, annual appropriations having been made by Congress for the same. However, this publication is not without expense to the Smithsonian fund, as the preparation of suitable material for an appendix<sup>1</sup> has been a constant and increasing charge upon the Institution, amounting to several thousand dollars each year.

Under the head of Proceedings of the National Museum are to be included (1) the bulletins and (2) the proceedings. The former are short monographs on "biological subjects, check lists, taxonomic systems," etc., and furnish a prompt publication of the descriptions of minerals received and a means of "illustrating the mineral, botanical, zoölogical, and ethnological specimens belonging to the Museum." This series was commenced in 1875, thirty-two bulletins having been published since that time.

The "proceedings" consist of shorter and less elaborate publications for the purpose of giving recent accounts of new accessions to the Museum and newly acquired facts.

These irregular publications are collected into bound volumes, one being published annually. This series commenced in 1878, and now numbers nine volumes, "averaging about six hundred and fifty pages, and illustrated with numerous wood-cut plates."

Though not so important, viewed in the light of scientific research, as other publications, this last series is exceedingly useful in bearing directly upon general education.

The last series to be mentioned is that of the annual report of the Bureau of Ethnology, of which only four large size volumes of royal octavo form have been published. They contain matter of great importance to the ethnologist and are valuable additions to science.

The Smithsonian Institution has always distributed these volumes of the different series with a liberality limited only by their resources for printing.

The publication has been able to print in ordinary cases only from 1,250 to 1,500 copies of each work, three-fourths of which go to supply the regular list of correspondence and the exchanges. "The distribution is made first to those learned societies of the first class which give to the Institution in return complete sets of their own publications; secondly, to a class of the first class furnishing catalogues of their libraries and of their publications relative to their organization and history; and, lastly, to public libraries in this country having twenty

<sup>1</sup> The appendix is published in the *Proceedings* of the Institution, since 1880.

five thousand volumes; fourthly, they are presented in some cases to still smaller libraries, especially if no other copies of the Smithsonian publications are given in the same place and a large district would otherwise be unsupplied; lastly, to institutions devoted exclusively to the promotion of particular branches of knowledge, such of its publications are given as relate to their special objects."<sup>1</sup>

The system of exchanges was adopted in 1846, and was continued through twenty years of successful work, when a new duty was laid upon the Institution by an act of Congress in 1867, creating the international exchange of Government publications, combining the interests of knowledge with a Government agency for the distribution of official documents. The amount of work accomplished in this system of exchanges is truly wonderful. In its present condition there were shipped in 1886-87 "10,000 domestic and over 40,000 foreign packages of books," and this was increased in the following year to over "12,000 domestic and 62,000 foreign packages."

From 1868, the time of the first operation of the act regulating Governmental exchanges, to 1881, the expenses of the said exchanges were borne entirely by the Smithsonian Institution. In the latter year Congress made an appropriation of \$3,000 for that purpose, and it has been gradually increased from year to year. Prior to 1880 the Institution expended \$92,386.29 for exchanges, two-thirds of which was on account of the Government; since 1880, \$96,065.85 have been expended, and \$57,500 of this sum were paid by the Government.<sup>2</sup>

This will suffice to show something of the nature and amount of work done by the Institution in the interest of knowledge. In addition to this, thousands of scholars and individuals throughout this country and others have been benefited by the answers to scientific questions that come annually to the Institution concerning specimens of minerals, plants, and animals, or to questions for more general information.

#### CHANGES IN THE WORK OF THE INSTITUTION.

During the administration of Professor Henry, a man who devoted his entire life largely to scientific investigation, there was a tendency to shut off all departments of the Institution not in the direct line of original research. The first to be disposed of was the museum of art, which passed under the control of the managers of the Corcoran Art Gallery.

Later the meteorological bureau was made a separate department; formerly all observations were carried on under the direction of the Smithsonian. The herbarium was also disposed of, and is now under a separate management. An attempt was made to place the *min* under separate charge, but it did not succeed.

The library was deposited with the Congressional Library in 1867

<sup>1</sup> Report of Secretary for 1884, 25.

<sup>2</sup> *Ibid*, 28.

account of lack of room and in order to place the books in a fire-proof building. When placed there the library numbered about forty thousand volumes, obtained chiefly through exchanges, and containing the publications of learned societies as well as representing the history of every branch of positive science.

The library has increased so that it now numbers about two hundred and fifty thousand volumes. A small number, about one-twentieth of the whole, is kept in the museum building for a reference library, under the titles of "secretary's library" and "editor's library."

During the year 1887-88 there were 18,918 books, pamphlets, and maps deposited in the several libraries by the Smithsonian Institution.

The treatment of the Smithsonian fund has been quite remarkable. Besides carrying on the great work of investigation, the Institution has now a library equal in value to the original fund or bequest, and buildings equal to more than half the original bequest, while the present fund is nearly two hundred thousand dollars greater than the original bequest. The regents were authorized to make additions to the fund by such deposits as they saw fit, not exceeding, with the original bequest, one million dollars.

The amount of work now required is even greater than the present limited means will accomplish. If the permanent fund were increased to the full limit, as it ought to be, the work could be rendered by far more effective.

#### NATIONAL APPROPRIATIONS.

*Statement of appropriations by Congress for the National Museum from 1857 to 1888, in dollars.*

| Date of act.  | Preservation of collections. | Furniture and fixtures. | Heating and lighting. |
|---------------|------------------------------|-------------------------|-----------------------|
| March 3, 1857 |                              | \$15,000.00             |                       |
| June 2, 1858  | \$4,000.00                   |                         |                       |
| March 3, 1859 | 4,000.00                     |                         |                       |
| June 13, 1861 | 4,000.00                     |                         |                       |
| March 2, 1862 | 4,000.00                     |                         |                       |
| March 1, 1862 | 4,000.00                     |                         |                       |
| March 3, 1863 | 4,000.00                     |                         |                       |
| July 2, 1864  | 4,000.00                     |                         |                       |
| April 7, 1866 | 4,000.00                     |                         |                       |
| July 26, 1866 | 4,000.00                     |                         |                       |
| March 2, 1867 | 2,000.00                     |                         |                       |
| July 30, 1868 | 4,000.00                     |                         |                       |
| March 3, 1869 | 4,000.00                     |                         |                       |
| July 15, 1870 | 10,000.00                    | 1,000.00                |                       |
| March 4, 1871 | 10,000.00                    | 10,000.00               |                       |
| May 17, 1871  |                              | 5,000.00                |                       |
| June 1, 1872  | 2,000.00                     |                         |                       |
| March 3, 1873 | 15,000.00                    | 5,000.00                |                       |

<sup>1</sup> Appropriations for printing are not included in this list.



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<sup>2</sup> Smith. Mis. Coll., XVII, 949.

<sup>3</sup> *Ibid.*, 837.

<sup>4</sup> *Ibid.*, 838.

<sup>5</sup> *Ibid.*, 839.

<sup>6</sup> *Ibid.*, 849.

partment of the National Educational Association, held at Washington, February, 1866, where it was resolved to petition Congress in favor of a National Bureau of Education."<sup>1</sup>

The memorial was presented in the House of Representatives, with an accompanying bill for the proposed Bureau, by General Garfield, who on this occasion made an able speech on national education. The bill was passed by the House, and subsequently by the Senate, with an amendment creating a department of education instead of a bureau, as was first proposed.

The act took effect in July, 1868, and was amended in June of the following year, by abolishing the Department of Education and creating a Bureau of Education as an Office in the Department of the Interior, the form in which it has since existed. Section first of the text of the act sets forth the chief objects of the Bureau of Education as follows:

*"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That there shall be established, at the city of Washington, a Department of Education, for the purpose of collecting such statistics and facts as shall show the condition and progress of education in the several States and Territories, and of diffusing such information respecting the organization and management of school systems, and methods of teaching, as shall aid the people of the United States in the establishment and maintenance of efficient school systems, and otherwise promote the cause of education throughout the country."*

As defined by this act, the range of the work of the Bureau is unlimited as far as all classes and grades of schools are concerned, and, in fact, the subject of higher education and libraries, with all means of education, should receive as much attention as the common schools.

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#### MAGNITUDE OF THE WORK DONE.

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A few statistics kindly furnished by the present Commissioner, Col. H. N. R. Dawson, will show what is being done by the Government.

<sup>1</sup> Report of the Commissioner for 1886-87, 13.

<sup>2</sup> *Ibid*, 12.

## BUREAU OF EDUCATION.

81

APPROPRIATIONS FOR SUPPORT.<sup>1</sup>*Ordinary appropriations for the Bureau of Education, 1867 to 1889.*

| Year ended<br>June 30 | Amounts appropriated for— |                                        |                             |                            | U. S. Statutes. |         |
|-----------------------|---------------------------|----------------------------------------|-----------------------------|----------------------------|-----------------|---------|
|                       | Salaries.                 | Library and<br>contingent<br>expenses. | Documents<br>and<br>museum. | All specified<br>purposes. | Vol.            | Page.   |
| 1867.....             | \$3,000                   |                                        |                             | \$13,000                   | 15              | 8       |
| 1868.....             | 9,400                     |                                        |                             | 9,400                      | 15              | 8       |
| 1869.....             | 9,400                     | \$10,000                               |                             | 20,000                     | 15              | 106     |
| 1870.....             | 5,400                     | 600                                    |                             | 6,000                      | 15              | 291     |
| 1871.....             | 8,640                     | 5,860                                  |                             | 14,500                     | 16              | 242     |
| 1872.....             | 10,240                    | 16,260                                 |                             | 26,500                     | 16              | 496     |
| 1873.....             | 17,640                    | 17,210                                 |                             | 34,850                     | 17              | 76      |
| 1874.....             | 17,640                    | 17,210                                 |                             | 34,850                     | 17              | 604     |
| 1875.....             | 18,360                    | 17,210                                 |                             | 35,570                     | 18              | 105     |
| 1876.....             | 18,360                    | 14,210                                 |                             | 35,570                     | 18              | 265-6   |
| 1877.....             | 18,160                    | 12,900                                 |                             | 31,060                     | 19              | 165     |
| 1878.....             | 17,440                    | 11,400                                 |                             | 28,840                     | 19              | 316     |
| 1879.....             | 17,320                    | 11,400                                 |                             | 28,720                     | 20              | 200-1   |
| 1880.....             | 17,320                    | 18,400                                 | \$1,000                     | 36,720                     | 20              | 396     |
|                       |                           |                                        |                             |                            | 21              | 23-28   |
| 1881.....             | 22,180                    | 18,400                                 | 5,000                       | 45,580                     | 21              | 233     |
|                       |                           |                                        |                             |                            | 21              | 276     |
| 1882.....             | 25,180                    | 18,775                                 | 6,000                       | 50,155                     | 21              | 406     |
| 1883.....             | 44,780                    | 5,975                                  | 2,000                       | 52,535                     | 22              | 249-250 |
| 1884.....             | 44,780                    | 3,875                                  | 2,000                       | 50,455                     | 22              | 557-58  |
| 1885.....             | 44,780                    | 3,375                                  | 2,000                       | 49,935                     | 23              | 188     |
| 1886.....             | 45,420                    | 4,175                                  | 3,000                       | 52,595                     | 23              | 419     |
| 1887.....             | 45,420                    | 4,175                                  | 2,500                       | 52,095                     | 24              | 202     |
| 1888.....             | 45,420                    | 3,000                                  | 2,500                       | 50,920                     | 24              | 625     |
| 1889.....             | 45,420                    | 3,500                                  | 2,000                       | 50,920                     |                 |         |
|                       | 541,560                   | 221,510                                | 28,000                      | 814,110                    |                 |         |

Appropriations for printing not included in this summary.

SSO—No. 1—G



## CHAPTER III.

### STATE AID TO HIGHER EDUCATION IN NEW ENGLAND.

Education in early New England arose from philanthropic and charitable rather than from political motives. The idea of strengthening government was subordinate to the ideas of an enlightened church society and an educated ministry. In advancing this proposition it must be remembered that the influence of religion on government was very great. This influence is observed in the laws and customs which modified the entire civic polity. Economic and political measures were never lost sight of in the founding of the colonies, but they were always blended with religious interests. Nearly all of the early schools were the direct product of religious impulse, but the government felt it no less a duty on this account to foster and assist them. The people were keenly conscious of their duty to aid education in every conceivable way, not only as individuals, but through their representatives in the General Court. The self-sacrifices of individuals and the ready responses of legislative bodies to the calls of higher education will ever remain to arrest the attention of the thoughtful in succeeding generations.

The attitude of the "State" in early times toward colleges was quite notable. While it did not assume any especial control of the institutions, and gave them at all times an independent existence, yet in a general sense it felt responsible for their establishment and maintenance. The founders of the New England Colleges entertained no such idea of a State institution for the specific support of the civil authority, independent of religious control, as was embodied in the plans of Thomas Jefferson for a school system in Virginia. Though the New England movement was religious, philanthropic, and charitable, rather than political, yet the general ends sought after were the same. Through an educated ministry, an intelligent body of worshipers, and by means of the cultured individual, the entire community was to receive lasting benefit. Much stress was also laid upon the education of the poor, while the untutored Indian was not omitted in the provisions for higher education.

The zeal of the people for education was manifested alike through the self-denial of individuals and the action of their representatives in the General Court. It would have been nothing remarkable for a few

tional applies to every department of knowledge that can be illustrated by a specimen or picture; and in this department, as in others, the possibility of an intelligent use of museums is slowly dawning upon teachers. A dingy room filled with unclassified material will soon be an indication that there are other fossils filling professors' chairs.

The present use of the American Museum of Natural History, in Central Park, New York, for the systematic instruction of professional teachers is a commendable illustration of progress in this line. A regular course of lectures is formed, which are delivered in regular order on Saturdays, in a small hall prepared for the work, with a seating capacity of 275 persons. The trustees hired Chickering Hall for the benefit of the autumn course (1887). The average number attending was 1,329. Besides the use of materials for illustration, stereopticon slides are used to reproduce non-portable materials.

The State has indorsed the work by a liberal appropriation for carrying it on.

#### PUBLIC LECTURES.

One of the early plans was to have in connection with the Museum a course of lectures, more or less popular in their nature. The board of regents accordingly authorized a system of free lectures in the Smithsonian Institution. The first lectures were delivered in 1848, there being devoted to this purpose the sum of eighty dollars. The amounts appropriated for lectures increased from year to year, together with the incidentals connected with illustrating lectures, the greatest appropriation reaching the sum of \$1,044.32, in the year 1863. In 1865 the lecture courses were suspended for a term of five years, being resumed in 1870, and suspended again in 1876. From 1848 to 1876 lectures were continued through twenty-four years, during which time there was appropriated for this purpose out of the Smithsonian fund the total sum of \$21,701.28.<sup>1</sup> The lectures at present held in the hall of the Museum have been under the auspices of the learned societies, though of a somewhat miscellaneous and popular nature. These were largely attended. Many of the lectures had direct reference to the work of the Museum, and were illustrated by specimens.<sup>2</sup>

#### PUBLICATIONS AND EXCHANGES.

"The diffusion of knowledge among men" has been effected in different ways by the Institution, but chiefly through publications and exchanges. The principal publications are of five series, as follows:<sup>3</sup> (1) Contributions to knowledge; (2) Miscellaneous collections; (3) Annual report of the board of regents to Congress; (4) The proceedings of the National Museum; and (5) Annual reports of the Bureau of **Ethnology**.

<sup>1</sup> Smith. Mus. Coll., XVIII, 729.

<sup>2</sup> G. Brown Goode, Report for 1885, 21.

<sup>3</sup> Secretary's Report for 1887, 21 *et seq.*

The first series was commenced in 1848, and now numbers twenty-five volumes, composed of valuable papers of scientific research. The second series was commenced in 1862: though of less scientific importance than the first, it has increased far more rapidly, its published volumes now numbering thirty-three. The foregoing publications have been made at the expense of the Smithsonian income on permanent funds, while the remaining three series have been published at the expense of the Government, annual appropriations having been made by Congress for the same. However, this publication is not without expense to the Smithsonian fund, as the preparation of suitable material for an appendix has been a constant and increasing charge upon the Institution, amounting to several thousand dollars each year.

Under the head of Proceedings of the National Museum are to be included (1) the bulletins and (2) the proceedings. The former are short monographs on "biological subjects, check lists, taxonomic systems," etc., and furnish a prompt publication of the descriptions of minerals received and a means of "illustrating the mineral, botanical, zoological, and ethnological specimens belonging to the Museum." This series was commenced in 1875, thirty-two bulletins having been published since that time.

The "proceedings" consist of shorter and less elaborate publications for the purpose of giving recent accounts of new accessions to the Museum and newly acquired facts.

These irregular publications are collected into bound volumes, one being published annually. This series commenced in 1878, and now numbers nine volumes, "averaging about six hundred and fifty pages, and illustrated with numerous wood-cut plates."

Though not so important, viewed in the light of scientific research, as other publications, this last series is exceedingly useful in bearing directly upon general education.

The last series to be mentioned is that of the annual report of the Bureau of Ethnology, of which only four large size volumes of royal octavo form have been published. They contain matter of great importance to the anthropologist and are valuable additions to science.

The Smithsonian managers have always distributed these volumes of the different series with a liberality limited only by their resources for printing.

The Institution has been able to print in ordinary cases only from 1,250 to 1,500 copies of each work, three-fourths of which go to supply the regular lists of correspondence and the exchanges. "The distribution is made first to those learned societies of the first class which give to the Institution in return complete sets of their own publications; secondly, to colleges of the first class furnishing catalogues of their libraries and students and publications relative to their organization and history; thirdly, to public libraries in this country having twenty-

"The age of science is the age of science and industry," since 1880.



five thousand volumes; fourthly, they are presented in some cases to still smaller libraries, especially if no other copies of the Smithsonian publications are given in the same place and a large district would otherwise be unsupplied; lastly, to institutions devoted exclusively to the promotion of particular branches of knowledge, such of its publications are given as relate to their special objects."<sup>1</sup>

The system of exchanges was adopted in 1816, and was continued through twenty years of successful work, when a new duty was laid upon the Institution by an act of Congress in 1867, creating the international exchange of Government publications, combining the interests of knowledge with a Government agency for the distribution of official documents. The amount of work accomplished in this system of exchanges is truly wonderful. In its present condition there were shipped in 1886-87 "10,000 domestic and over 40,000 foreign packages of books," and this was increased in the following year to over "12,000 domestic and 62,000 foreign packages."

From 1868, the time of the first operation of the act regulating Governmental exchanges, to 1881, the expenses of the said exchanges were borne entirely by the Smithsonian Institution. In the latter year Congress made an appropriation of \$3,000 for that purpose, and it has been gradually increased from year to year. Prior to 1880 the Institution expended \$92,386.29 for exchanges, two-thirds of which was on account of the Government; since 1880, \$96,065.85 have been expended, and \$57,500 of this sum were paid by the Government.<sup>2</sup>

This will suffice to show something of the nature and amount of work done by the Institution in the interest of knowledge. In addition to this, thousands of scholars and individuals throughout this country and others have been benefited by the answers to scientific questions that come annually to the Institution concerning specimens of minerals, plants, and animals, or to questions for more general information.

#### CHANGES IN THE WORK OF THE INSTITUTION.

During the administration of Professor Henry, a man who devoted his entire life largely to scientific investigation, there was a tendency to shut off all departments of the Institution not in the direct line of original research. The first to be disposed of was the museum of art, which passed under the control of the managers of the Corcoran Art Gallery.

Later the meteorological bureau was made a separate department; formerly all observations were carried on under the direction of the Smithsonian. The herbarium was also disposed of, and is now under a separate management. An attempt was made to place the museum under separate charge, but it did not succeed.

The library was deposited with the Congressional Library in 1867,

<sup>1</sup> Report of Secretary for 1884, 25.

<sup>2</sup> *Ibid*, 28.

account of lack of room and in order to place the books in a fire-proof building. When placed there the library numbered about forty thousand volumes, obtained chiefly through exchanges, and containing the publications of learned societies as well as representing the history of every branch of positive science.

The library has increased so that it now numbers about two hundred and fifty thousand volumes. A small number, about one-twentieth of the whole, is kept in the museum building for a reference library, under the titles of "secretary's library" and "editor's library."

During the year 1887-88 there were 18,918 books, pamphlets, and maps deposited in the several libraries by the Smithsonian Institution.

The treatment of the Smithsonian fund has been quite remarkable. Besides carrying on the great work of investigation, the Institution has now a library equal in value to the original fund or bequest, and buildings equal to more than half the original bequest, while the present fund is nearly two hundred thousand dollars greater than the original bequest. The regents were authorized to make additions to the fund by such deposits as they saw fit, not exceeding, with the original bequest, one million dollars.

The amount of work now required is even greater than the present limited means will accomplish. If the permanent fund were increased to the full limit, as it ought to be, the work could be rendered by far more effective.

#### NATIONAL APPROPRIATIONS.

*Statement of appropriations by Congress for the National Museum from 1857 to 1888, inclusive.*

| Date of act.  | Preservation of collections. | Furniture and fixtures. | Heating and lighting. |
|---------------|------------------------------|-------------------------|-----------------------|
| March 3, 1857 |                              | \$15,000.00             |                       |
| June 2, 1858  | 44,000.00                    |                         |                       |
| March 1, 1859 | 4,000.00                     |                         |                       |
| June 25, 1859 | 4,000.00                     |                         |                       |
| March 2, 1860 | 4,000.00                     |                         |                       |
| March 1, 1862 | 4,000.00                     |                         |                       |
| March 3, 1863 | 4,000.00                     |                         |                       |
| July 2, 1864  | 4,000.00                     |                         |                       |
| April 7, 1866 | 4,000.00                     |                         |                       |
| July 26, 1866 | 4,000.00                     |                         |                       |
| March 2, 1867 | 1,000.00                     |                         |                       |
| July 20, 1868 | 4,000.00                     |                         |                       |
| March 3, 1869 | 4,000.00                     |                         |                       |
| July 15, 1870 | 10,000.00                    | 1,000.00                |                       |
| March 4, 1871 | 10,000.00                    | 10,000.00               |                       |
| May 18, 1872  |                              | 5,000.00                |                       |
| June 2, 1872  | 1,000.00                     | 5,000.00                |                       |
| March 3, 1873 | 15,000.00                    | 1,000.00                |                       |
|               |                              | 1,000.00                |                       |

\*Appropriations for printing are not included in this list.

## 78 FEDERAL AND STATE AID TO HIGHER EDUCATION.

*Statement of appropriations by Congress for the National Museum, etc.—Continued.*

| Date of act.          | Preservation of collections. | Furniture and fixtures. | Heating and lighting. |
|-----------------------|------------------------------|-------------------------|-----------------------|
| June 23, 1874 .....   | \$20,000.00                  | \$10,000.00             | .....                 |
| March 3, 1875 .....   | 20,000.00                    | { 10,000.00             | .....                 |
| July 31, 1876 .....   | 10,000.00                    | { 2,500.00              | .....                 |
| March 3, 1877 .....   | 18,000.00                    | .....                   | .....                 |
| June 20, 1878 .....   | 18,000.00                    | .....                   | .....                 |
| March 3, 1879 .....   | { 23,000.00                  | .....                   | .....                 |
| June 16, 1880 .....   | { 4,000.00                   | .....                   | .....                 |
| March 3, 1881 .....   | 45,000.00                    | 50,000.00               | .....                 |
| March 3, 1881 .....   | 55,000.00                    | 60,000.00               | 25,000.00             |
| March 6, 1882 .....   | .....                        | 30,000.00               | .....                 |
| August 7, 1882 .....  | 75,000.00                    | 60,000.00               | 6,000.00              |
| August 4, 1886 .....  | 149.16                       | .....                   | .....                 |
| March 3, 1883 .....   | 20,000.00                    | 60,000.00               | 6,000.00              |
| July 7, 1884 .....    | 91,000.00                    | 40,000.00               | 8,000.00              |
| March 3, 1885 .....   | 95,000.00                    | { 40,000.00             | { 9,000.00            |
| .....                 | .....                        | { 2,891.42              | { 631.37              |
| August 4, 1886 .....  | 106,500.00                   | 40,000.00               | 11,000.00             |
| March 3, 1887 .....   | 116,000.00                   | 40,000.00               | 12,000.00             |
| October 2, 1888 ..... | 125,000.00                   | 40,000.00               | 12,000.00             |
| Total .....           | 1,015,649.16                 | 562,391.42              | 68,531.37             |

<sup>1</sup> Deficiency of 1882, but appropriated in August, 1886.

### BUREAU OF EDUCATION.<sup>1</sup>

When we contemplate the vast amount of useful work that is now being done by this department of the Government in the collection and dissemination of knowledge, it seems strange that the United States should have existed ninety years as a nation before this institution was called into existence. Though the Bureau was established according to the needs and demands of education, it has served to give strength and vigor to every department of knowledge.

### SKETCH OF ITS ORIGIN.

It is impossible to treat fairly the subject of higher education in the United States without placing among the foremost agencies for the promotion of knowledge this Government clearing-house for statistical and historical information. Educators, political economists, and statesmen felt the need of some central agency by which the general educational statistics of the country could be collected, preserved, condensed, and properly arranged for distribution. This need found expression finally in the action taken at a convention of the superintendence

<sup>1</sup> For a full discussion of the subject, see "The National Bureau of Education; Work and Legislation," by Alexander Shurs, D. D., and "Answers to Inquiries of the Bureau of Education; Its Work and History," by Charles Warren, M. D.

partment of the National Educational Association, held at Washington, February, 1866, where it was resolved to petition Congress in favor of a National Bureau of Education."<sup>1</sup>

The memorial was presented in the House of Representatives, with an accompanying bill for the proposed Bureau, by General Garfield, who on this occasion made an able speech on national education. The bill was passed by the House, and subsequently by the Senate, with an amendment creating a department of education instead of a bureau, as was first proposed.

The act took effect in July, 1868, and was amended in June of the following year, by abolishing the Department of Education and creating a Bureau of Education as an Office in the Department of the Interior, the form in which it has since existed. Section first of the text of the act sets forth the chief objects of the Bureau of Education as follows:

*"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That there shall be established, at the city of Washington, a Department of Education, for the purpose of collecting such statistics and facts as shall show the condition and progress of education in the several States and Territories, and of diffusing such information respecting the organization and management of school systems, and methods of teaching, as shall aid the people of the United States in the establishment and maintenance of efficient school systems, and otherwise promote the cause of education throughout the country."*

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<sup>1</sup> Report of the Commissioner for 1886-87, 13.

<sup>2</sup> *Ibid*, 12.

## BUREAU OF EDUCATION.

81

APPROPRIATIONS FOR SUPPORT.<sup>1</sup>*Ordinary appropriations for the Bureau of Education, 1867 to 1899.*

| Year ended<br>June 30. | Amounts appropriated for— |                                        |                             |                            | U. S. Statutes. |         |
|------------------------|---------------------------|----------------------------------------|-----------------------------|----------------------------|-----------------|---------|
|                        | Salaries.                 | Library and<br>contingent<br>expenses. | Documents<br>and<br>museum. | All specified<br>purposes. | Vol.            | Page.   |
| 1867.....              | \$3,000                   |                                        |                             | \$13,000                   | 15              | 8       |
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| 1870.....              | 5,400                     | 600                                    |                             | 6,000                      | 15              | 291     |
| 1871.....              | 8,640                     | 5,860                                  |                             | 14,500                     | 16              | 242     |
| 1872.....              | 10,240                    | 10,260                                 |                             | 20,500                     | 16              | 490     |
| 1873.....              | 17,640                    | 17,210                                 |                             | 34,850                     | 17              | 76      |
| 1874.....              | 17,640                    | 17,210                                 |                             | 34,850                     | 17              | 504     |
| 1875.....              | 18,360                    | 17,210                                 |                             | 35,570                     | 18              | 105     |
| 1876.....              | 18,360                    | 14,210                                 |                             | 35,570                     | 18              | 365-6   |
| 1877.....              | 18,160                    | 12,900                                 |                             | 31,060                     | 19              | 165     |
| 1878.....              | 17,440                    | 11,400                                 |                             | 28,840                     | 19              | 318     |
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| 1883.....              | 44,500                    | 5,975                                  | 2,000                       | 52,555                     | 22              | 249-250 |
| 1884.....              | 44,500                    | 3,875                                  | 2,000                       | 50,375                     | 22              | 557-54  |
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| 1888.....              | 45,420                    | 3,000                                  | 2,500                       | 50,920                     | 24              | 625     |
| 1889.....              | 45,420                    | 3,500                                  | 2,000                       | 50,920                     |                 |         |
|                        | 551,500                   | 221,510                                | 28,000                      | 814,110                    |                 |         |

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SSO—No. 1—6



## CHAPTER III.

### STATE AID TO HIGHER EDUCATION IN NEW ENGLAND.

Education in early New England arose from philanthropic and charitable rather than from political motives. The idea of strengthening government was subordinate to the ideas of an enlightened church society and an educated ministry. In advancing this proposition it must be remembered that the influence of religion on government was very great. This influence is observed in the laws and customs which modified the entire civic polity. Economic and political measures were never lost sight of in the founding of the colonies, but they were always blended with religious interests. Nearly all of the early schools were the direct product of religious impulse, but the government felt it no less a duty on this account to foster and assist them. The people were keenly conscious of their duty to aid education in every conceivable way, not only as individuals, but through their representatives in the General Court. The self-sacrifices of individuals and the ready responses of legislative bodies to the calls of higher education will ever remain to arrest the attention of the thoughtful in succeeding generations.

The attitude of the "State" in early times toward colleges was quite notable. While it did not assume any especial control of the institutions, and gave them at all times an independent existence, yet in a general sense it felt responsible for their establishment and maintenance. The founders of the New England Colleges entertained no such idea of a State institution for the specific support of the civil authority, independent of religious control, as was embodied in the plans of Thomas Jefferson for a school system in Virginia. Though the New England movement was religious, philanthropic, and charitable, rather than political, yet the general ends sought after were the same. Through an educated ministry, an intelligent body of worshipers, and by means of the cultured individual, the entire community was to receive lasting benefit. Much stress was also laid upon the education of the poor, while the untutored Indian was not omitted in the provisions for higher education.

The zeal of the people for education was manifested alike through the self-denial of individuals and the action of their representatives in the General Court. It would have been nothing remarkable for a few



people about Harvard to have supported their own local institution for the sake of the welfare of their children and the prosperity of their own community. But when we consider that the outlying provinces of Maine, New Hampshire, and Connecticut sent to Harvard their contributions, raised by private subscription and by town taxes, then we see how great was the interest in education for its own sake.

It is worthy of note, also, that the first school established by the people in New England was a college. They aimed at the higher education first, believing that it would strengthen and support secondary education. Two objects seem to be superior to all others in the founding of Harvard as well as Yale, (1) an educated ministry, and (2) the preparation of teachers for grammar schools. The full force of the modern school system was by no means grasped at that early day. The idea of the college as the first institution in a new country still survives. It has been the foremost school in the States of the West and South, and with it has been carried the fundamental truth of the necessity of higher education for the support of primary and secondary schools. The order of development of the modern school system has been through the college to the grammar schools, to the primary schools, and finally to the kindergarten.

The institution of town schools, supported by local taxation, was a universal practice in New England. There were different phases of this system in different provinces, but all maintaining the same general characteristics. Sometimes the local taxes were administered through the general legislative body, at others through local boards. The system of grammar schools is the prototype of the modern high schools, supported in most instances by local revenues.

The amounts granted for the support and encouragement of higher education were small, compared to the sums now granted in other parts of the United States for the same purpose. However, they were given when needed, usually at the request of the colleges, and the amounts given were of far greater value then than the same amounts would be to-day. In many instances they should be considered liberal donations.

The States of New England are not as liberal to-day in proportion as the colonies were in respect to higher education. But there is not now so much need as then. Many changes have taken place. Theological schools have sprung up; colleges have developed into universities. While it still remains true that colleges are necessary for the support of the ministry, it no longer follows that it is the chief aim of all the educational institutions of New England to supply an educated ministry. The State has sought its own work in other channels, and the theological seminary is no longer the object of its support. Private endowments are building magnificent institutions of learning. Education is universal and special: universal in representing all classes, and special in its application to the different pursuits in life.

The New England college supplied the most pressing need of the times; nevertheless, it was nothing more than a training school for young men, a boarding school without schools or professorships. It was exceedingly narrow in its object and work. But those were narrow times, though life was intense. I speak of this because New England has been struggling against the old regime, her mediæval inheritance, in attempting to enlarge and diversify the means of education.

At first all the settlements centered their efforts on a single institution. Subsequently, when thickly settled communities sprang up elsewhere, other colleges were founded for the convenience of the people or for especial religious purposes.

One thing was favorable to New England education, that is, the quick and certain execution of the law. Whatever was ordered by the legislative bodies was sure of execution. In more sparsely settled portions of the land, under weaker governments, this is not always the case.

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#### MASSACHUSETTS.

Massachusetts was the pioneer State in the establishment and maintenance of a system of public instruction by legislative enactment. Here the first action was taken by the representatives of the people for the support of general education; here the first tax was levied for the support of common schools; here the first State aid was granted for higher education; and it is to Massachusetts that the origin of the system of land grants is to be referred—a system adopted by the National Government and by so many States as to be considered well-nigh continental. The influence of this State upon the school laws, and educational systems and methods of other States has been very pronounced. The other New England States, especially, have as far as possible imitated her example, and followed closely in the wake of her progress, while the influence of the New England system on the Middle, Southern, and Western States has ever been recognized.

#### FOUNDING OF HARVARD COLLEGE.

Sixteen years after the landing of the Pilgrims at Plymouth, and only six years after the first settlement at Boston, the energetic citizens of the new colony began to provide for higher education. The General Court of the colony of Massachusetts, which met in Boston on the 8th of September, 1636, "agreed to give four hundred pounds towards a school or college, whereof two hundred pounds to be paid the next year and two hundred pounds when the work is finished, and the next court to appoint when and what building."<sup>1</sup>

This seems a very small beginning for the foundation of a college,

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<sup>1</sup> Mass. Colonial Court Records, I, 183.

especially when we consider the enormous funds now expended for public education and the magnificent endowments of private institutions. But at that time there were less than four thousand people in the colony, and the per-capita tax must have been half a dollar, a rate which at the present day would yield in the State of Massachusetts the enormous sum of over one million dollars. It must also be considered in estimating the value of donations and grants to education at this early period that "These sums in reality represent values ten or even fifty fold greater than the same amounts would to-day."<sup>1</sup>

But the Legislature, or General Court as it was called, did not stop here, but granted in 1640 the ferry between Boston and Charlestown for the support of the college,<sup>2</sup> and ordered an annual rate of one hundred pounds for the same purpose.<sup>3</sup> A committee was appointed by the court to proceed with the erection of buildings, and Mr. Eaton was appointed to take charge of the institution and superintend the erection of the first building. The court also granted five hundred acres of land to Mr. Eaton for his support, provided that he would devote his life to the college work. Subsequently Mr. Eaton was accused of tyrannizing over his students; he was tried, and dismissed, and his successor was appointed.

#### ATTITUDE OF THE STATE.

"Thus," says Prof. C. K. Adams,<sup>4</sup> "we find the Legislature exercising supreme authority in six different acts: (1) In making a special grant for a college; (2) in laying an annual tax for its support; (3) in determining where the college should be located; (4) in appointing a committee for the erection of buildings; (5) in appointing an officer to the general charge of the institution and providing for his support at the expense of the State, and finally (6) in putting the officer so appointed on trial, removing him, and appointing his successor." But this was not a State institution in the fullest sense, according to the modern usage of the term, for private benevolence was constantly solicited and as constantly given for its support.

While the State controlled it and assisted it constantly in its days of feebleness, the permanent endowments came largely from private sources. The first private gift was made by John Harvard, after whom the college was named (1639), who in 1638 gave his library and half of his estate. There is a discrepancy in the statement of authors concerning the amount of the donation. It is generally stated to be eight hundred pounds. According to the records the amount was £779 17s. 2d., from which only £395 3s. were realized.<sup>5</sup> The sacrifices of individ-

<sup>1</sup> Cf. Gary Fisher: *Harvard and the first American university*, 116.

<sup>2</sup> *Records*, I, 294.

<sup>3</sup> *Id.*, II, 23.

<sup>4</sup> *Id.*, XXXVII, 71.

<sup>5</sup> Quincy: *History of Harvard University*, I, 460-62.

uals constantly went hand in hand with the generosity and patronage of the State, and upon this basis the first schools of Massachusetts were built. Individuals who could not give even a small subscription in ready money contributed to the support of the college by farm produce or by household articles and books. Among other donations are mentioned "a great silver salt;" "a silver beer-bowl;" "one fruit-dish, one silver sugar spoon, and one silver-tipped jug;" "a silver tankard;" "a pewter flagon;" "corn and meat;" "thirty ewe sheep and their lambs;" "lumber;" "horses,"<sup>1</sup> etc.

These small beginnings rapidly increased in amount until private donations far exceeded in amount the aid of the State. But the function of the State that seems ever since to have been exercised in the United States is that of fostering and protecting education and encouraging and stimulating private benevolence in this direction. The Legislature took the initiative in founding the college, gave by right in perpetuity the Boston Ferry for its support, and came to its timely assistance whenever there was need, at the same time encouraging and protecting to the fullest extent private benevolence toward the institution.

In 1640 an act of the Legislature established a board of overseers of Harvard College, and made provision for control and management as follows:

"It is, therefore, ordered by this Court, and the authority thereof, that the Governor and Deputy Governor for the time being and all the magistrates of this jurisdiction together with the teaching elders of the six next adjoining towns; viz: Cambridge, Watertown, Charlestown, Boston, Roxbury, and Dorchester, and the president of the said college for the time being shall from time to time have full power to make and establish all such orders, statutes, and constitutions as they shall see necessary for the institution, guiding, and furthering of the said college and the several members thereof from time to time, in piety, morality, and learning; and also to dispose, order, and manage to the use and behoof of the said college and the members thereof, all gifts, legacies, bequeaths, revenues, lands, and donations as either have been, are, or shall be conferred, bestowed, or any ways shall fall or come to the said college."<sup>2</sup>

During the first six years, before the creation of the board of overseers, the General Court controlled the college by direct enactments; afterward its internal working was given over to the control of the overseers. It was not until 1650<sup>3</sup> that a charter was granted and the governing body assumed corporate form. But the corporate body was subordinate to the overseers appointed by the Legislature. The appendix to the charter in 1657 gave the corporation independent action. "Provided, always, that the corporation shall be responsible unto, and those

<sup>1</sup> Report of the Board of Education, XL, 49.

<sup>2</sup> *Ibid.*, III, 195.

<sup>3</sup> Court Records, I.

orders and by-laws shall be alterable by, the overseers according to their discretion."<sup>1</sup>

This charter, as amended, remained the fundamental authority of college government, and "hath been conformed to ever since."<sup>2</sup> Many attempts were made to sever the connection of the college and the State, but without avail.

#### CONSTITUTIONAL PROVISIONS.

The Constitution of 1780 confirmed the rights, privileges, and powers of the officers as held under the old charter. It also provided for the transmission of the powers of the old board of overseers to their successors, composed of the Governor, Lieutenant Governor, Council, and Senate of the Commonwealth, "who, with the president of Harvard College, for the time being, together with the ministers of the Congregational churches in the towns of Cambridge, Watertown, Charlestown, Boston, Roxbury, and Dorchester, mentioned in the said act, shall be, and hereby are, vested with all the powers and authority belonging or in any way appertaining to the overseers of Harvard College; *provided*, that nothing herein shall be construed to prevent the Legislature of this Commonwealth from making such alterations in the government of the said university as shall be conducive to its advantage and the interest of the republic of letters, in as full a manner as might have been done by the Legislature of the late province of the Massachusetts Bay."<sup>3</sup>

The attitude of the State toward education at the time of the adoption of the Constitution in 1780 is clearly set forth in section 2 of the same chapter, as follows:

"Wisdom and knowledge, as well as virtue, diffused generally among the body of the people, being necessary for the preservation of their rights and liberties, and as these depend on spreading the opportunities and advantages of education in the various parts of the country, and among the different orders of the people, it shall be the duty of Legislatures and magistrates, in all future periods of this Commonwealth, to cherish the interests of literature and the sciences, and all seminaries of them, especially the University at Cambridge, public schools, and grammar-schools in the towns; to encourage private societies and public institutions, [by] rewards and immunities, for the promotion of agriculture, arts, sciences, commerce, trades, manufactures, and a natural history of the country, etc."<sup>4</sup>

The State government continued to exercise its functions of control, and through various statutes of the Commonwealth it has been represented on the board of overseers by the chief State officers until 1865, when an act was passed severing the relation of the government to the

<sup>1</sup> Peirce: History of Harvard, 150.

<sup>2</sup> Hutchinson, I, 175 (1764).

<sup>3</sup> Constitution, Chap V, sec. 1, art. 2.

<sup>4</sup> *Ibid.*, Chap. V, sec. 2.

college and providing for the election of its overseers by the alumni, that is, "such persons as have received from the college the degree of bachelor of arts or master of arts or any ordinary degree, voting on commencement day in the city of Cambridge."<sup>1</sup>

#### APPROPRIATIONS BY THE LEGISLATURE.

The generous sentiments of the State have been attested by repeated appropriations for the support of Harvard College and the respective academies throughout the State. In the course of the colonial and provincial periods, the Legislature of Massachusetts made no less than one hundred and three distinct grants to the college, although a number of these grants were unproductive. It is held by Quincy<sup>2</sup> that the first four hundred pounds were only paid in part. It seems highly probable that the court paid them for current expenses, and that the transaction was never entered upon the college records.

The ferry heretofore mentioned yielded an average of fifty pounds<sup>3</sup> per annum, and in 1777 the annual rental was one hundred pounds. At this date the general court divested the college of the control of the ferry, but granted in lieu of said revenue the sum of two hundred pounds per annum for forty years.<sup>4</sup> The reason for this change was that projects were under consideration for bridging the river. In 1785 the sum of two hundred pounds was ordered to be paid by the Charles River bridge corporation as a compensation for the loss of the ferry, and in 1792 a like sum was taxed on the West Boston Bridge Company.<sup>5</sup>

The earliest direct tax on record for the support of common or public schools was established by an act of the General Court in 1644, which ordered that one peck of corn, or its equivalent (12*d*), should be paid by each family for the support of the college.<sup>6</sup> Three years later the court again showed its favor by ordering that the professors and students should be exempt from "general training,"<sup>7</sup> and the charter of 1650 provided that the property of the president and college, not exceeding five hundred pounds per annum, should be exempt from all taxes or rates; also the estates of the president, fellows, and scholars, not exceeding one hundred pounds to each person; and the officers and servants, to the number of ten, were exempt from all taxes and rates whatsoever.<sup>8</sup>

It is not possible in the scope of this paper to follow carefully all the details of legislation, but we shall endeavor to show how a zealous people, acting through their representatives, drew upon every available resource for the support of higher education, and a few of the numerous grants of the Court and the town will be mentioned.

<sup>1</sup> Laws of 1865.

<sup>2</sup> History of Harvard, 460.

<sup>3</sup> Quincy, I, 453.

<sup>4</sup> *Ibid*, II, 271.

<sup>5</sup> Report Mass. Board Ed., XL, 49, appendix.

<sup>6</sup> Court Records, II, 86.

<sup>7</sup> *Ibid*, 222.

<sup>8</sup> Bush, Harvard University, 91.



In 1638 the town of Cambridge gave two and three-fourths acres of land for building sites, and in 1652 granted an additional tract of one hundred acres. In 1644 the court granted the sum of one hundred and fifty pounds to build the president's house, and in 1655 a grant of thirty pounds was made for the relief of President Chauncy, to whom five hundred acres of land were also given, on condition that he remain three years in his place.

In 1652 the court granted eight hundred acres of land to the college; in 1653, two thousand acres; and in 1683, one thousand acres.<sup>1</sup>

In 1657 the court also granted two thousand acres in Pequot County, and subsequently, in 1682, granted a large tract on Merriconeag Neck. Unfortunately neither of these latter grants were ever available.<sup>2</sup>

In 1683 the town of Cambridge gave three and one-half acres to the college.

The General Court of 1718 voted to devote three thousand five hundred pounds to build Massachusetts Hall. The hall was completed and occupied two years after the act of appropriation. In 1725 this was followed by another money grant of one thousand pounds, for building the president's house, and subsequently, in 1763, four thousand eight hundred and thirteen pounds seven shillings were given to build Hollis Hall. In the following year the General Court voted two thousand pounds for the rebuilding of Harvard Hall. Meanwhile the gifts of land continued, the principal ones being as follows:

In 1715, province lands within the bounds of Hopkinton.

In 1719, two hundred and fifty acres in Lunenburg and two hundred and fifty acres in Townsend.

In 1762, one sixty-fourth of each of twelve townships lying between the Penobscot and St. Croix Rivers, and of one township lying between the Great Ossipee and the mountains.

In 1764, one sixty-fourth part of each of the townships lying east of the Saco River.

In 1768, one eighty-third part of a township lying north of the Androscoggin River.

In 1770, one eighty-fourth part of a township lying at Eastern Bay.

In 1771, one eighty-fourth of each of five townships lying east of Saco River.

In 1774, a tract of land lying east of the Saco River, containing eleven thousand acres.

In 1725 the Legislature fixed the salary of the president at four hundred pounds per annum, and granted to him, in addition, the future rents and incomes of Massachusetts Hall.<sup>3</sup>

The General Court also authorized lotteries as follows: The first in 1765, of three thousand two hundred pounds, for the purpose of building; another in 1794, of eight thousand pounds, and a third in 1806, of thirty thousand dollars, for the same purpose.

<sup>1</sup> Court Records, III, 299.

<sup>2</sup> Quincy, I, 512.

<sup>3</sup> *Ibid.*, 378.

In 1809 the Legislature granted a township of land in what is now the State of Maine for the support of the professorship in natural history.

But the largest grant of the Legislature was made by an act of 1814, which provided that ten-sixteenths<sup>1</sup> of the bank tax, amounting to ten thousand dollars, should be paid annually to the college for a term of ten years, yielding in all the sum of one hundred thousand dollars.

#### MUSEUM OF COMPARATIVE ZOOLOGY.

Upon taking the professorship of zoölogy in the scientific school of Harvard, Professor Agassiz found that there were no collections for illustration, and no funds set apart for the purchase of the same. Professor Agassiz provided specimens at his own expense, which he afterward sold to the school in 1852. Six years later, Mr. Francis E. Gray left by will the sum of fifty thousand dollars for maintaining a Museum of Comparative Zoölogy.<sup>2</sup>

In 1859, at the recommendation of Governor Banks, the Legislature voted to aid the museum to the extent of one hundred thousand dollars, while private donations continued. The State appropriated ten thousand dollars in 1863 to publish an Illustrated Catalogue of the Museum, and five years later the Legislature passed an act granting the sum of twenty-five thousand dollars a year for three years, provided that a similar sum should be raised each year by subscription.

In 1874 it was determined to raise an "Agassiz Memorial Fund;" two hundred and sixty thousand dollars were soon subscribed, and the State added to the amount the sum of fifty thousand dollars.

In regard to the Museum of Comparative Zoölogy, the whole property of which was transferred to the president and fellows of Harvard College, we find that the State has contributed to its aid the amount of two hundred and thirty-five thousand dollars.

Until the establishment of the National Museum and the Smithsonian Institution, this institution was without a rival in the United States; and "as to the illustration of natural science the one collection in the United States that has an acknowledged rank throughout the world, is the one fostered by the wise and careful bounty of the State of Massachusetts at Cambridge."<sup>3</sup>

#### SUMMARY OF GRANTS.

The whole amount of grants made by the Legislature of Massachusetts to Harvard College from the date of its founding until 1786, the principal part of which was expended in the erection of buildings and the payment of salaries to the president and the professors, was in sterling

<sup>1</sup> Laws of Massachusetts, IV, 388.

<sup>2</sup> Mass Rep., XL, 62, appendix.

<sup>3</sup> President White in Am. Jour. Soc. Sci., VII, 304.



£5,556 12s 8d, and in lawful currency £27,330 9s 6½d, respectively equal to \$24,696.14 and \$91,101.51.<sup>1</sup>

The records of the first half-century of the existence of the college, that is from 1636 to 1686, show that the court granted only £550 sterling and £2,870 currency, exclusive of the ferry grant, and during the same time the donations of individuals amounted to £5,091 sterling and £4,640 currency. During this period the ferry paid, as it is estimated, about £50 per annum, or the total sum of £2,300 in currency.

Approximating a general summary, we have as follows:

| <i>Aid by the Legislature.</i>                       |              |
|------------------------------------------------------|--------------|
| Grants from 1636 to 1786 .....                       | \$115,797.73 |
| West Boston Bridge Company at £200 per annum.....    | 20,000.00    |
| Charles River Bridge Company at £300 per annum ..... | 10,000.00    |
| Museum of Comparative Zoölogy .....                  | 235,000.00   |
| Raised by lotteries (about) .....                    | 69,000.00    |
| Bank tax from 1814 to 1824.....                      | 100,000.00   |
| Total amount of money grants .....                   | 549,793.73   |
| Total amount of land grants (about) .....            | 46,000.00    |

*Private donations.*

|                                                                                                                      |                |
|----------------------------------------------------------------------------------------------------------------------|----------------|
| The amount of private donations during the period from 1638 to 1848 is estimated at <sup>2</sup> .....               | \$1,228,069.74 |
| In addition to this, real estate, granted by the city of Cambridge between the years 1638 and 1641, amounted to..... | 4,857 acres.   |

It is seen that in the earlier part of the existence of the college, as in the more recent times, the private donations were always greater than the public grants.

"Let not," says Quincy, "these statements lead to the conclusion that the degree of patronage extended by the General Court was of little worth, or is intended to be undervalued. Notwithstanding the deficiency in direct donatives the college is largely indebted to them for the actual prosperity to which, during the period in question, it attained."<sup>3</sup>

Harvard has apparently attained a position where it no longer needs the aid and supervision of the State, receiving, as it does, support from magnificent individual endowments; but the aid of the State in supporting the institution when struggling as the foremost college in a new country can not be easily over estimated in its importance.

MASSACHUSETTS ACADEMIES.

Perhaps a close classification would exclude the academies and high schools of Massachusetts from the range of higher education; but these schools have borne such an intimate relation with all the interests of higher education that they ought not to be passed unnoticed. Considered historically, it is quite impossible to draw a line defining higher education by the names that institutions bear. The terms "univer-

<sup>1</sup> Mass. Rep., XL, 49, appendix.

<sup>2</sup> History of Harvard, I, 41.

<sup>3</sup> *Ibid.*, 44.

sity," "college," "academy," "grammar school," and "high school" are misleading in regard to the past as well as to the present. While the modern classification of public schools as "superior," "secondary," and "primary" is gaining uniformity, yet it is difficult to reduce all of the early schools to this gradation.

The school system of colonial Massachusetts comprised common schools, academies, and a university. But this term "common" frequently signified a school open to the admission of all classes, and the academies were frequently called grammar schools, while the academies proper bore much the same relation to the university that the modern college does to the modern university. The term "free school" also signified a school "free" or open to all comers, although tuition was frequently charged. The earliest school laws made it a duty of the towns to provide "free schools," supported in part by taxation in the towns where they were located and in part by the tuition of the pupils.

Rev. Charles Hammond, in his excellent paper on "New England Academies and Classical Schools," offers the opinion that the early designation of the term "free," as applied to grammar schools and academies, had respect neither to cost or privileges, but to the nature and tendency of learning in its effect on the mind of the student and on the state of society. The schools were "free" because the education in them was liberal.<sup>1</sup> As to their nature and aims and their respective courses of study, the ancient grammar school is to be considered as equivalent to the modern high school, and the old academy as approximating the position of the modern college.

In the year 1642 the General Court passed an act relating to family education, and imposing fines upon parents who neglected the proper instruction of their children. The court also, in the same year, enlarged upon this idea by a brief educational code, which shows the solemnity with which they viewed the subject of education :

"It being the chief project of that old deluder, Satan, to keep men from the knowledge of the Scriptures as in former times keeping them in an unknown tongue, so in these latter times, by persuading from the use of tongues so at least that the true sense of the original might be clouded and corrupted with the false glosses of deceivers, and to the end that learning may not be buried in the grave of our forefathers, in church and commonwealth, the Lord assisting our endeavors :

"It is therefore ordered by this court and authority thereof that every township within this jurisdiction, after the Lord hath increased them to the number of fifty house-holders, shall then forthwith appoint one within their town to teach all such children as shall resort to him to write and read, whose wages shall be paid either by the parents or masters of such children, or by the inhabitants in general by way of supply as the major part of those who order the prudentials of the town shall appoint, provided that those who send their children be not op-

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<sup>1</sup> Report of the Commissioner of Education, 1863, 412.

pressed by paying much more than they can have them taught for in other towns.

"And it is further enacted, that when any town shall increase to the number of one hundred families as house-holders they shall set up a grammar school, the masters thereof being able to instruct youths so far as they may be fitted for the university; and if any town neglect the performance thereof above one year, then every such town shall pay five pounds per annum to the next such school till they shall perform this order."

The last<sup>1</sup> clause has been the fundamental law for the organization of the system of high schools and academies. The revised statutes of Massachusetts still provide that high schools shall be established in every town having five hundred inhabitants, and may be established in any town by the vote of the people; the said schools are to be supported by local taxation.

Many of the early grammar schools were of very excellent grade, sufficient to prepare students for Harvard College. Mather<sup>2</sup> says of them: "When scholars had so far profited at the grammar schools that they could read any classical author into English and readily make and speak true Latin, and write it in verse as well as in prose, and perfectly decline the paradigms of nouns and verbs in the Greek tongue, they were judged capable of admission to Harvard College."

These grammar schools for a long time supplied the demands of the people for training schools for the university. But in towns where they were not required by law, and in country places, academies sprang up to supply the needs of the people.

The academies were usually aided by the State by way of land endowments or by appropriations.

A joint committee of both houses reporting before the Massachusetts Legislature, February 27, 1797, fully stated the position of academies at large, and recommended that the State authorize certain grants of land to academies about to be formed.

The court accepted the report of the committee and ordered the grants of land as recommended.

The grants were "to be made to trustees of any association within the respective counties mentioned where there was no academy at present instituted, who shall first make application to the General Court." It was provided that a sum be secured for the use of said institution, and that the situation selected for the academy be approved by the Legislature. In the general report of the committee it was urged that every portion of the Commonwealth ought to be entitled to these appropriations "in aid of private donations;" that no academy should be established near one already existing; that the institutions should first be secured with funds and private endowments, and that the lands so granted should be in aid of the permanent fund.

<sup>1</sup> Massachusetts Records, II, 203.

<sup>2</sup> Magnalia, Vol. II, Book IV, 4.



The committee further report that there are already fifteen academies, besides the Derby School, but that the academy at Marblehead will probably serve only the purposes of a town school. The colleges already chartered would serve the purposes of academies, and including these it was proposed that there should be one academy for every twenty-five thousand inhabitants. "Of the fifteen academies already incorporated, seven have had grants of State lands, that at Fryeburg fifteen thousand acres, and the other six, at Machias, Hallowell, Berwick, Marblehead, Taunton, and Leicester, one township each." It was recommended in the future that one-half of a township, instead of a whole one, be granted to each academy.

Of the eight academies not endowed by the Commonwealth, nearly all were endowed either by towns or by individuals; but four, at Portland, Westfield, New Salem, and Plymouth, were to be each endowed with a half of a township.

The report of the committee adopted by the General Court shows conclusively that the Commonwealth, recognizing private endowments, proposed to supplement their work, and that the school system at this date was in the hands of the Legislature.

In another report of a similar committee, dated March 3, 1859,<sup>1</sup> Hon. Charles W. Upham, chairman, after reciting the above report, concludes: "The following principles appear to have been established as determining the relations of academies to the Commonwealth. They were to be regarded as in many respects and to a considerable extent public schools; as a part of an organized system of universal education; as opening the way of all the people to a higher order of instruction than the common schools can supply, and as a complement to them, towns, as well as the Commonwealth, were to share with individuals the character of founders or legal visitors of them. They were to be distributed as nearly as might be so as to accommodate the different districts or localities of the State according to a measure of population, that is, twenty-five thousand individuals. In this way they were to be placed within the reach of the whole people, and their advantages secured as equally and as effectively as possible, for the common benefit."

These early academies were carried on with varying success. One of the earliest academies in the province of Massachusetts was that of Byfield, taught for nineteen years by the celebrated Master Moody, and here were prepared for Harvard many students who afterward became eminent men. It was the success of this institution that led to the founding of the famous Phillips Academies at Andover and Exeter and that at Leicester.

The schools were modeled as nearly as possible after the "English great public schools," such as Harrow, Rugby, and Eton. They did not succeed in always furnishing a uniformly good curriculum, and in obtaining the heavy endowments that characterized the schools of

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<sup>1</sup> Report 1-68, 432.

orders and by-laws shall be alterable by, the overseers according to their discretion."<sup>1</sup>

This charter, as amended, remained the fundamental authority of college government, and "hath been conformed to ever since."<sup>2</sup> Many attempts were made to sever the connection of the college and the State, but without avail.

#### CONSTITUTIONAL PROVISIONS.

The Constitution of 1780 confirmed the rights, privileges, and powers of the officers as held under the old charter. It also provided for the transmission of the powers of the old board of overseers to their successors, composed of the Governor, Lieutenant Governor, Council, and Senate of the Commonwealth, "who, with the president of Harvard College, for the time being, together with the ministers of the Congregational churches in the towns of Cambridge, Watertown, Charlestown, Boston, Roxbury, and Dorchester, mentioned in the said act, shall be, and hereby are, vested with all the powers and authority belonging or in any way appertaining to the overseers of Harvard College; *provided*, that nothing herein shall be construed to prevent the Legislature of this Commonwealth from making such alterations in the government of the said university as shall be conducive to its advantage and the interest of the republic of letters, in as full a manner as might have been done by the Legislature of the late province of the Massachusetts Bay."<sup>3</sup>

The attitude of the State toward education at the time of the adoption of the Constitution in 1780 is clearly set forth in section 2 of the same chapter, as follows:

"Wisdom and knowledge, as well as virtue, diffused generally among the body of the people, being necessary for the preservation of their rights and liberties, and as these depend on spreading the opportunities and advantages of education in the various parts of the country, and among the different orders of the people, it shall be the duty of Legislatures and magistrates, in all future periods of this Commonwealth, to cherish the interests of literature and the sciences, and all seminaries of them, especially the University at Cambridge, public schools, and grammar-schools in the towns; to encourage private societies and public institutions, [by] rewards and immunities, for the promotion of agriculture, arts, sciences, commerce, trades, manufactures, and a natural history of the country, etc."<sup>4</sup>

The State government continued to exercise its functions of control, and through various statutes of the Commonwealth it has been represented on the board of overseers by the chief State officers until when an act was passed severing the relation of the government to

<sup>1</sup> Peirce: History of Harvard, 150.

<sup>2</sup> Hutchinson, I, 175 (1764).

<sup>3</sup> Constitution, Chap V, sec. 1, art. 4

<sup>4</sup> *Ibid.*, Chap. V, sec. 2.

college and providing for the election of its overseers by the alumni, that is, "such persons as have received from the college the degree of bachelor of arts or master of arts or any ordinary degree, voting on commencement day in the city of Cambridge."<sup>1</sup>

#### APPROPRIATIONS BY THE LEGISLATURE.

The generous sentiments of the State have been attested by repeated appropriations for the support of Harvard College and the respective academies throughout the State. In the course of the colonial and provincial periods, the Legislature of Massachusetts made no less than one hundred and three distinct grants to the college, although a number of these grants were unproductive. It is held by Quincy<sup>2</sup> that the first four hundred pounds were only paid in part. It seems highly probable that the court paid them for current expenses, and that the transaction was never entered upon the college records.

The ferry heretofore mentioned yielded an average of fifty pounds<sup>3</sup> per annum, and in 1777 the annual rental was one hundred pounds. At this date the general court divested the college of the control of the ferry, but granted in lieu of said revenue the sum of two hundred pounds per annum for forty years.<sup>4</sup> The reason for this change was that projects were under consideration for bridging the river. In 1785 the sum of two hundred pounds was ordered to be paid by the Charles River bridge corporation as a compensation for the loss of the ferry, and in 1792 a like sum was taxed on the West Boston Bridge Company.<sup>5</sup>

The earliest direct tax on record for the support of common or public schools was established by an act of the General Court in 1644, which ordered that one peck of corn, or its equivalent (12*d*), should be paid by each family for the support of the college.<sup>6</sup> Three years later the court again showed its favor by ordering that the professors and students should be exempt from "general training,"<sup>7</sup> and the charter of 1650 provided that the property of the president and college, not exceeding five hundred pounds per annum, should be exempt from all taxes or rates; also the estates of the president, fellows, and scholars, not exceeding one hundred pounds to each person; and the officers and servants, to the number of ten, were exempt from all taxes and rates whatsoever.

It is not possible in the scope of this paper to follow carefully all the details of legislation, but we shall endeavor to show how a zealous people, acting through their representatives, drew upon every available resource for the support of higher education, and a few of the numerous grants of the Court and the town will be mentioned.

<sup>1</sup>Laws of 1787.

<sup>2</sup>History of Mass., vol. 4, 401.

<sup>3</sup>Quincy, I, 135.

<sup>4</sup>*Ibid.*, II, 251.

Report Mass. Board Ed., XL, 19, appendix.

Court Records, II, 86.

<sup>7</sup>*Ibid.*, 222.

<sup>8</sup>Bush, Harvard University, 91.

In 1638 the town of Cambridge gave two and three-fourths acres of land for building sites, and in 1652 granted an additional tract of one hundred acres. In 1644 the court granted the sum of one hundred and fifty pounds to build the president's house, and in 1655 a grant of thirty pounds was made for the relief of President Chauncy, to whom five hundred acres of land were also given, on condition that he remain three years in his place.

In 1652 the court granted eight hundred acres of land to the college; in 1653, two thousand acres; and in 1683, one thousand acres.<sup>1</sup>

In 1657 the court also granted two thousand acres in Pequot County, and subsequently, in 1682, granted a large tract on Merriconeag Neck. Unfortunately neither of these latter grants were ever available.<sup>2</sup>

In 1683 the town of Cambridge gave three and one-half acres to the college.

The General Court of 1718 voted to devote three thousand five hundred pounds to build Massachusetts Hall. The hall was completed and occupied two years after the act of appropriation. In 1725 this was followed by another money grant of one thousand pounds, for building the president's house, and subsequently, in 1763, four thousand eight hundred and thirteen pounds seven shillings were given to build Hollis Hall. In the following year the General Court voted two thousand pounds for the rebuilding of Harvard Hall. Meanwhile the gifts of land continued, the principal ones being as follows:

In 1715, province lands within the bounds of Hopkinton.

In 1719, two hundred and fifty acres in Lunenburg and two hundred and fifty acres in Townsend.

In 1762, one sixty-fourth of each of twelve townships lying between the Penobscot and St. Croix Rivers, and of one township lying between the Great Ossipee and the mountains.

In 1764, one sixty-fourth part of each of the townships lying east of the Saco River.

In 1768, one eighty-third part of a township lying north of the Androscoggin River.

In 1770, one eighty-fourth part of a township lying at Eastern Bay.

In 1771, one eighty-fourth of each of five townships lying east of Saco River.

In 1774, a tract of land lying east of the Saco River, containing eleven thousand acres.

In 1725 the Legislature fixed the salary of the president at four hundred pounds per annum, and granted to him, in addition, the future rents and incomes of Massachusetts Hall.<sup>3</sup>

The General Court also authorized lotteries as follows: The first in 1765, of three thousand two hundred pounds, for the purpose of building; another in 1794, of eight thousand pounds, and a third in 1814, of thirty thousand dollars, for the same purpose.

<sup>1</sup> Court Records, III, 29.

<sup>2</sup> Quincy, I, 512.

<sup>3</sup> *Ibid.*, 378.

In 1809 the Legislature granted a township of land in what is now the State of Maine for the support of the professorship in natural history.

But the largest grant of the Legislature was made by an act of 1814, which provided that ten-sixteenths<sup>1</sup> of the bank tax, amounting to ten thousand dollars, should be paid annually to the college for a term of ten years, yielding in all the sum of one hundred thousand dollars.

#### MUSEUM OF COMPARATIVE ZOOLOGY.

Upon taking the professorship of zoölogy in the scientific school of Harvard, Professor Agassiz found that there were no collections for illustration, and no funds set apart for the purchase of the same. Professor Agassiz provided specimens at his own expense, which he afterward sold to the school in 1852. Six years later, Mr. Francis E. Gray left by will the sum of fifty thousand dollars for maintaining a Museum of Comparative Zoölogy.<sup>2</sup>

In 1859, at the recommendation of Governor Banks, the Legislature voted to aid the museum to the extent of one hundred thousand dollars, while private donations continued. The State appropriated ten thousand dollars in 1863 to publish an Illustrated Catalogue of the Museum, and five years later the Legislature passed an act granting the sum of twenty five thousand dollars a year for three years, provided that a similar sum should be raised each year by subscription.

In 1871 it was determined to raise an "Agassiz Memorial Fund;" two hundred and sixty thousand dollars were soon subscribed, and the State added to the amount the sum of fifty thousand dollars.

In regard to the Museum of Comparative Zoölogy, the whole property of which was transferred to the president and fellows of Harvard College, we find that the State has contributed to its aid the amount of two hundred and thirty five thousand dollars.

Until the establishment of the National Museum and the Smithsonian Institution, this institution was without a rival in the United States; and "as to the illustration of natural science the one collection in the United States that has an acknowledged rank throughout the world, is the one fostered by the wise and careful bounty of the State of Massachusetts at Cambridge."

#### SUMMARY OF GRANTS.

The whole amount of grants made by the Legislature of Massachusetts to Harvard College from the date of its founding until 1786, the principal part of which was expended in the erection of buildings and the payment of salaries to the president and the professors, was in sterling

<sup>1</sup> *Journal of the Legislature*, IV, 28.

<sup>2</sup> *Journal of the Legislature*, p. 2.

<sup>3</sup> *Proceedings of the Acad. Nat. Sci.*, VII, 204.



£5,556 12s 8d, and in lawful currency £27,330 9s 6½d, respectively equal to \$24,696.14 and \$91,101.51.<sup>1</sup>

The records of the first half-century of the existence of the college, that is from 1636 to 1686, show that the court granted only £550 sterling and £2,870 currency, exclusive of the ferry grant, and during the same time the donations of individuals amounted to £5,091 sterling and £4,640 currency. During this period the ferry paid, as it is estimated, about £50 per annum, or the total sum of £2,300 in currency.

Approximating a general summary, we have as follows:

*Aid by the Legislature.*

|                                                      |              |
|------------------------------------------------------|--------------|
| Grants from 1636 to 1786 .....                       | \$115,797.73 |
| West Boston Bridge Company at £200 per annum .....   | 20,000.00    |
| Charles River Bridge Company at £300 per annum ..... | 10,000.00    |
| Museum of Comparative Zoölogy .....                  | 235,000.00   |
| Raised by lotteries (about) .....                    | 69,000.00    |
| Bank tax from 1814 to 1821 .....                     | 100,000.00   |
| Total amount of money grants .....                   | 549,797.73   |
| Total amount of land grants (about) .....            | 46,000.00    |

*Private donations.*

The amount of private donations during the period from 1638 to 1848 is estimated at: ..... \$1,222,029.74  
In addition to this, real estate, granted by the city of Cambridge between the years 1638 and 1641, amounted to ..... 4,857 acres.

It is seen that in the earlier part of the existence of the college, as in the more recent times, the private donations were always greater than the public grants.

"Let not," says Quincy, "these statements lead to the conclusion that the degree of patronage extended by the General Court was of little worth, or is intended to be undervalued. Notwithstanding the deficiency in direct donations the college is largely indebted to them for the actual prosperity to which, during the period in question, it attained."<sup>2</sup>

Harvard has apparently attained a position where it no longer needs the aid and supervision of the State, receiving, as it does, support from magnificent individual endowments; but the aid of the State in supporting the institution when struggling as the foremost college in a new country can not be easily over estimated in its importance.

MASSACHUSETTS ACADEMIES.

Perhaps a close classification would exclude the academies and high schools of Massachusetts from the range of higher education; but these schools have borne such an intimate relation with all the interests of higher education that they ought not to be passed unnoticed. Considered historically, it is quite impossible to draw a line defining education by the names that institutions bear. The terms

<sup>1</sup> Mass. Rep., XL, 49, appendix.

<sup>2</sup> History of Harvard, I, 4

<sup>3</sup> Ibid., 44.

sity," "college," "academy," "grammar school," and "high school" are misleading in regard to the past as well as to the present. While the modern classification of public schools as "superior," "secondary," and "primary" is gaining uniformity, yet it is difficult to reduce all of the early schools to this gradation.

The school system of colonial Massachusetts comprised common schools, academies, and a university. But this term "common" frequently signified a school open to the admission of all classes, and the academies were frequently called grammar schools, while the academies proper bore much the same relation to the university that the modern college does to the modern university. The term "free school" also signified a school "free" or open to all comers, although tuition was frequently charged. The earliest school laws made it a duty of the towns to provide "free schools," supported in part by taxation in the towns where they were located and in part by the tuition of the pupils.

Rev. Charles Hammond, in his excellent paper on "New England Academies and Classical Schools," offers the opinion that the early designation of the term "free," as applied to grammar schools and academies, had respect neither to cost or privileges, but to the nature and tendency of learning in its effect on the mind of the student and on the state of society. The schools were "free" because the education in them was liberal.<sup>1</sup> As to their nature and aims and their respective courses of study, the ancient grammar school is to be considered as equivalent to the modern high school, and the old academy as approximating the position of the modern college.

In the year 1642 the General Court passed an act relating to family education, and imposing fines upon parents who neglected the proper instruction of their children. The court also, in the same year, enlarged upon this idea by a brief educational code, which shows the solemnity with which they viewed the subject of education :

"It being the chief project of that old deluder, Satan, to keep men from the knowledge of the Scriptures as in former times keeping them in an unknown tongue, so in these latter times, by persuading from the use of tongues so at least that the true sense of the original might be clouded and corrupted with the false glosses of deceivers, and to the end that learning may not be buried in the grave of our forefathers, in church and commonwealth, the Lord assisting our endeavors :

"It is therefore ordered by this court and authority thereof that every township within this jurisdiction, after the Lord hath increased them to the number of fifty house holders, shall then forthwith appoint one within their town to teach all such children as shall resort to him to write and read, whose wages shall be paid either by the parents or masters of such children, or by the inhabitants in general by way of supply as the major part of those who order the prudentials of the town shall appoint, provided that those who send their children be not op-

<sup>1</sup>Report of the Commissioner of Education, 1868, 412.

pressed by paying much more than they can have them taught for in other towns.

"And it is further enacted, that when any town shall increase to the number of one hundred families as house-holders they shall set up a grammar school, the masters thereof being able to instruct youths so far as they may be fitted for the university; and if any town neglect the performance thereof above one year, then every such town shall pay five pounds per annum to the next such school till they shall perform this order."

The last<sup>1</sup> clause has been the fundamental law for the organization of the system of high schools and academies. The revised statutes of Massachusetts still provide that high schools shall be established in every town having five hundred inhabitants, and may be established in any town by the vote of the people; the said schools are to be supported by local taxation.

Many of the early grammar schools were of very excellent grade, sufficient to prepare students for Harvard College. Mather<sup>2</sup> says of them: "When scholars had so far profited at the grammar schools that they could read any classical author into English and readily make and speak true Latin, and write it in verse as well as in prose, and perfectly decline the paradigms of nouns and verbs in the Greek tongue, they were judged capable of admission to Harvard College."

These grammar schools for a long time supplied the demands of the people for training schools for the university. But in towns where they were not required by law, and in country places, academies sprang up to supply the needs of the people.

The academies were usually aided by the State by way of land endowments or by appropriations.

A joint committee of both houses reporting before the Massachusetts Legislature, February 27, 1797, fully stated the position of academies at large, and recommended that the State authorize certain grants of land to academies about to be formed.

The court accepted the report of the committee and ordered the grants of land as recommended.

The grants were "to be made to trustees of any association within the respective counties mentioned where there was no academy at present instituted, who shall first make application to the General Court." It was provided that a sum be secured for the use of said institution, and that the situation selected for the academy be approved by the Legislature. In the general report of the committee it was urged that every portion of the Commonwealth ought to be entitled to these appropriations "in aid of private donations;" that no academy should be established near one already existing; that the institutions should first be secured with funds and private endowments, and that the so granted should be in aid of the permanent fund.

<sup>1</sup> Massachusetts Records, II, 205.

<sup>2</sup> Magalia, Vol. II, Book IV, 4.

The committee further report that there are already fifteen academies, besides the Derby School, but that the academy at Marblehead will probably serve only the purposes of a town school. The colleges already chartered would serve the purposes of academies, and including these it was proposed that there should be one academy for every twenty-five thousand inhabitants. "Of the fifteen academies already incorporated, seven have had grants of State lands, that at Fryeburg fifteen thousand acres, and the other six, at Machias, Hallowell, Berwick, Marblehead, Taunton, and Leicester, one township each." It was recommended in the future that one-half of a township, instead of a whole one, be granted to each academy.

Of the eight academies not endowed by the Commonwealth, nearly all were endowed either by towns or by individuals; but four, at Portland, Westfield, New Salem, and Plymouth, were to be each endowed with a half of a township.

The report of the committee adopted by the General Court shows conclusively that the Commonwealth, recognizing private endowments, proposed to supplement their work, and that the school system at this date was in the hands of the Legislature.

In another report of a similar committee, dated March 3, 1859,<sup>1</sup> Hon. Charles W. Upham, chairman, after reciting the above report, concludes: "The following principles appear to have been established as determining the relations of academies to the Commonwealth. They were to be regarded as in many respects and to a considerable extent public schools; as a part of an organized system of universal education; as opening the way of all the people to a higher order of instruction than the common schools can supply, and as a complement to them, towns, as well as the Commonwealth, were to share with individuals the character of founders or legal visitors of them. They were to be distributed as nearly as might be so as to accommodate the different districts or localities of the State according to a measure of population, that is, twenty-five thousand individuals. In this way they were to be placed within the reach of the whole people, and their advantages secured as equally and as effectively as possible, for the common benefit."

These early academies were carried on with varying success. One of the earliest academies in the province of Massachusetts was that of Byfield, taught for nineteen years by the celebrated Master Moody, and here were prepared for Harvard many students who afterward became eminent men. It was the success of this institution that led to the founding of the famous Phillips Academies at Andover and Exeter and that at Leicester.

The schools were modeled as nearly as possible after the "English great public schools," such as Harrow, Rugby, and Eton. They did not succeed in always furnishing a uniformly good curriculum, and in obtaining the heavy endowments that characterized the schools of

<sup>1</sup> Report 1858, 132.

England. We find them drawing their support chiefly from four sources: (1) private subscriptions and endowments, (2) town appropriations, (3) tuition of scholars, and (4) State grants. Notwithstanding that the income from all these sources was utilized, their early support was but meagre. Much to our surprise, too, we find the good people indulging in lotteries, as in case of Leicester Academy. An act of the General Court of June, 1785, granted a lottery to the trustees, not to exceed six hundred pounds; also an act of the General Court of 1791 granted to the trustees the privilege of a second lottery, which yielded \$1,419.22.

There are many of these early institutions, such as the Phillips Academy, the Boston Latin School, and others, which still retain much of their original character; but the greater number of academies and grammar schools have passed into the modern high school system. By an act of the Legislature in 1826 the high schools were more thoroughly provided for, the present system being then inaugurated. The establishment of a school fund in 1834, and of a Board of Education three years later, helped to strengthen and develop the system. By the law now in force every town of five hundred inhabitants is obliged to provide for a public high school supported by taxation.<sup>1</sup> Any town that neglects to comply with the law must forfeit a sum equal to twice the highest sum ever before voted for schools in that place.

Mr. Boutwell, Secretary of the Massachusetts Board of Education, in his report of 1860 says: "In many of these schools better training is furnished than was given at Harvard College at the time of the adoption of the Constitution."

In 1838 there were only fourteen high schools in Massachusetts; in 1852, sixty-four; in 1856, eighty; in 1860, one hundred and two; in 1865, one hundred and twenty; in 1868, one hundred and sixty-four; in 1866, one hundred and seventy-five; in 1871, one hundred and eighty-one; in 1873, one hundred and ninety; in 1874, two hundred and eight; in 1875, two hundred and twelve; in 1888, two hundred and thirty. This constant increase has been caused by new creation or by the absorption of the older institutions. As the older institutions gave way before the new régime, there has been needless prejudice against the former.

#### WILLIAMS COLLEGE.

Among the older institutions of Massachusetts, Williams College received at first considerable assistance from the State. In the year 1750 the General Court granted to Col. Ephraim Williams, the founder of the college, "two hundred acres of land in East Hoosac, now Adams, on condition of his erecting and keeping in repair for twenty years a grist-mill and saw-mill for the use of the settlers."<sup>2</sup> Subsequently Massachusetts was planted here, and Colonel Williams was appo-

<sup>1</sup> Chap. 27, Revised Statutes (1871) sec. 2.

<sup>2</sup> Mass. Rep., XL, Appendix, 64.

commander of the line of forts west of the Connecticut. He was killed in 1755, but in his will he gave the greater part of his property for the support of a free school in West Hoosac, to be called after his name. Under the charge of the executors the funds increased until the year 1785, when a board of trust was incorporated on their application to establish a free school in Williamstown.

The executors paid over to this board of trust nearly eleven thousand dollars. In 1788 the trustees ordered the erection of a building, which was completed in 1790 and opened for the purpose of a school in 1791, thirty-six years after the death of the founder.

The Legislature incorporated Williams College and transferred to the trustees all the property of the free school. The enterprise well started, the Legislature began to give the growing institution needed assistance. In 1804 it granted a strip of land "of no great value, to Williams and Bowdoin Colleges, which was followed in 1805 by the grant of a township to Williams College, which sold for \$4,500, and also the grant of a township in 1809, which sold for \$5,000. In February, 1811, the Legislature granted, from the proceeds of the tax on banks, the sum of \$3,000 annually for ten years. The Legislature continued from time to time its assistance to the college. The whole sum granted by the State previous to 1860 amounted to \$157,500.<sup>1</sup>

#### AMHERST COLLEGE.

The assistance given to Amherst College by the State has been comparatively small. The early life of the institution was one of vicissitudes, and its struggle for existence was opposed by Harvard College and by the citizens of the eastern part of the State as well.

A memorial was presented to the General Court as early as January 20, 1762, setting forth that "there are a great number of people in the county of Hampshire and places adjacent, disposed to promote learning, and by reason of their great distance from other colleges and the great expense of their education there, many of good natural genius are prevented a liberal education, and a large country filling up at the north-west of them which will send a great number of men of letters."<sup>2</sup>

But the aspirations of the men in the western part of the State were not to be realized for many years. A bill establishing an academy in the western part of the State was lost, and the subsequent charter incorporating Queens College was never granted, owing to the opposition of Harvard and its friends, although the charter was made out by the Governor of the State and had a strong following in the west.

Amherst Academy, opened in 1814, formally dedicated in the following year, and incorporated in 1816, was the nucleus of Amherst College. In 1815 the Franklin County Association of Ministers took action toward the founding of a college, recommending that it be established at

<sup>1</sup> Mass. Rep., XL, appendix, 69.

<sup>2</sup> Mass. Rep., XL, appendix, 67.

Amherst; subsequently the trustees of the academy became the trustees of the college. In the meantime the General Court had granted to the academy half a township of land in Maine; the academy, however, continued its corporate existence until 1858, at which time it was changed into a high school. The college was not opened until 1821 and received its charter in 1825, although an application for the same had been made in 1823, but had been defeated by various parties.

The institution continued to grow for eleven years, until in 1836 the number of students had reached an aggregate of 259; then came a decline, and nine years thereafter there were only 118 students.

At this time a great effort was made to raise funds and put the college on a proper footing. The State came to the assistance of the college with an appropriation of twenty-five thousand dollars. Over one hundred thousand dollars were raised during the years 1846-47. The State has contributed in all the sum of \$52,500, or only a third as much as to Williams College. The institution has, however, received generous support from its own alumni and from individual friends.

#### AGRICULTURAL COLLEGE AT AMHERST.

Under the act of Congress of July 2, 1862, granting public lands to the several States for the support of colleges of agriculture and the mechanic arts, the State of Massachusetts received three hundred and sixty thousand acres in land scrip. The proceeds of this gift were divided by acts of the Legislatures of 1861 and 1863, respectively, between the Massachusetts Institute of Technology at Boston and the Massachusetts Agricultural College at Amherst; two-thirds of the endowment was devoted to the college and one-third to the institute.

Scientific education, previous to this date, had received some attention, but its support had hitherto been derived from private donations, with the exception that the State had granted one hundred thousand dollars toward the building of the Museum of Comparative Zoölogy.

The Massachusetts School of Agriculture was incorporated in 1856, six years before the appropriation by the General Government. The subject at this time was receiving attention in the foremost States of the Union, and was agitated by the General Government itself. But it was difficult at this time to inaugurate the new movement. For lack of means to carry on the enterprise the school was not established, and the charter was transferred in 1860 to several enterprising citizens of Springfield.<sup>1</sup> After consultation with the leading agriculturists of the western part of the State, it was determined to open the college in that city, and to raise seventy-five thousand dollars for its support.

At the breaking out of the War operations were suspended, until the year 1863, when the Legislature took the affair in hand.

By an act of the Legislature approved April 23, 1863, the Agricultural College was established, and the following named persons -

<sup>1</sup> Rep. Com. Educ., 1868, 249.

designated trustees of the institution: the Governor of the Commonwealth, the Secretary of the State Board of Education, the secretary of the board of agriculture, and the president of the faculty; these were to be *ex officio* members of the corporation, and there were also fourteen other citizens named in the act. The trustees were to assume direct control in the organization and government of the college, subject to the approval of the Legislature.

In stating the design of the college the words of the act of Congress in the gift were quoted, viz: "the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, \* \* \* in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life."<sup>1</sup>

The college was to be located at Amherst, provided that the town would subscribe the required amount, namely, seventy-five thousand dollars. Amherst having complied with the law in this respect, the college was duly located there in 1864. Building was at once begun, and the institution was opened for students in October, 1867. A beautiful site had been chosen, and a farm of three hundred and eighty-one acres purchased for experimental purposes.

Contrary to the design of the act, the sum of forty-one thousand dollars was ordered by the Legislature (April 11, 1864) to be paid for the farm out of the proceeds of the land scrip fund. This was to have been kept as a productive fund by the right interpretation of the act of Congress.

The Legislature began its assistance by an act of 1864, which voted ten thousand dollars for founding purposes. Including this and later grants the list of appropriations by the State is as follows:

|                              |          |
|------------------------------|----------|
| 1864, for founding purposes  | \$10,000 |
| 1865, to aid re-establishing | 10,000   |
| 1866, for building purposes  | 50,000   |
| 1867, for building purposes  | 50,000   |
| 1870, for building purposes  | 25,000   |
| 1871, for building purposes  | 50,000   |
| 1874, for current expenses   | 15,000   |
| Total by the State (1874)    | 210,000  |

In 1883 the Legislature passed an act granting ten thousand dollars annually for the support of the Agricultural College. The total amount of State appropriations up to 1888 is \$560,575.

In addition to the above is to be noted the sum of \$75,000, subscribed by the town of Amherst.

The value of the property of the college in 1887 was \$269,644.12.

The entire productive fund of the United States grant is \$219,000, and of the State grant is \$141,575.35, or a total of \$360,575.35, two-thirds

<sup>1</sup>U. S. Statutes at Large, XII, 563. Rep. Com. Educ. 1878, 133.



of the income of which goes to the college, and one-third to the Massachusetts Institute of Technology. The income for the college from this source in 1887 was \$9,835.35. There are various other funds, mostly scholarships, amounting to the sum of \$20,605.19.<sup>1</sup>

#### MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

As early as 1858-'59 liberal minded gentlemen were considering the question of establishing in Massachusetts an institute of technology in connection with the Museum of Natural History. After repeated attempts of the associated institutions of Natural History Society, Horticultural Society, Society of Arts and Sciences, and others, a report was prepared by Professor William Rogers setting forth the objects and plans of an institute of technology. The report was accepted in 1860 by the committee of the associated institutions and furnished the framework on which the present institute has been built.

There was a preliminary and informal organization in January, 1861, and an application was made to the Legislature for a charter and a grant of land.

After this there were large private donations and contributions by legacies amounting to about three hundred and seventy thousand dollars. In 1863 the Legislature appropriated three-tenths of the proceeds of the national land grant of 1862.

The following statement of the relations of the institute to the State has been furnished by good authority:

"By an act of 1887 the Legislature of Massachusetts offered us \$100,000 on condition of founding twenty free scholarships. We declined the offer, on the ground that twenty free scholarships meant to us a loss of \$4,000 income, and that we could not rely upon getting much more than this sum annually out of the \$100,000. We were not willing to be represented as having received a large gift from the State when in reality, the proposed grant would bring us no financial relief or strength, since we can have all the pupils at \$200 a year whom we are able to provide for.

"Upon this, the Legislature the next year made a clear grant of \$100,000 upon condition of our accepting the grant of the year before on the terms stated. This we did, and all but \$50,000 of the money has been paid over to us, and the twenty free scholarships have been established. Now, upon this showing, some people would say that the State had given us \$200,000. We prefer to say that the State has given us \$100,000, and has bought \$100,000 worth of tuition from us, for the benefit of deserving young men, citizens of the commonwealth.

"This is all that Massachusetts has ever given us *directly* in money but many years ago, complaint having been made that the State sold its United States land scrip at very inadequate prices, the

<sup>1</sup> Report of Trustees, 1888, 24.

monwealth added a sum, which I recall at about \$141,000, to the capital of the fund derived from the foregoing source. Of the *income* of this fund the Institute of Technology regularly receives one-third, so that, again, one might say that the State had in this instance given to the school a little less than \$50,000. Inasmuch, however, as the State has never made the money over to us, and as the State might possibly refuse to continue the appropriation under which the income is paid to us, the question just how the matter shall be stated becomes a difficult one.

"This is all which Massachusetts has given us in money, upon **any** construction of the statutes. In addition, we have derived from the State the benefit of a right of perpetual occupancy of the land on which our buildings stand, subject to the condition that we shall never build over more than one-third the ground. It is difficult to say just what this privilege was worth at the time it was conferred upon us. At the time the grant was made the State was selling the land next to us (slightly to be preferred, by reason of being nearer the public garden) at a rate which would have made *the fee* of our tract worth about \$120,000. But we did not get the fee, and our easement was qualified, as I have told you. The grant was also accompanied by the condition that if when all the lands surrounding us had been sold it should not be made to appear to the satisfaction of commissioners to be for the purpose appointed by the Governor, that the price of such surrounding lands had been raised sufficiently above their then appraised value (at which value the State was earnestly desirous of selling as rapidly as possible) to make the treasury good for not selling our tract, then, in that case, the Institute of Technology should be required to pay for the land. This we have never been called upon to do, and I therefore conclude that the grant made to us by the State in the foregoing instance cost the treasury nothing, but was in fact only a part of the general scheme of advertisement by which the State undertook to promote the sale and settlement of the Back Bay lands, which were then, and for a long time thereafter, vastly in excess of the demand.

#### WORCESTER FREE INSTITUTE.

Worcester Institute was founded in 1865 through private beneficence for the purpose of training boys in the mechanical arts. The State then gave fifty thousand dollars to augment the endowment. Though the institute may not be termed a school of higher learning in the philosophic sense of the term, yet it gives theoretical and practical courses in mechanical and civil engineering, chemistry, physics, modern languages, etc. It deserves to be mentioned among the worthy State institutes of Massachusetts.

Massachusetts has thus shown herself ever ready to aid all of her educational enterprises, and they have been at once the glory and the support of the State. By wise laws, by land grants, by taxation, by

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gifts, and by every means at her command, the work of education has been supported. In accordance with the generous sentiments expressed in the Constitution and otherwise, the statutes provide, "That the personal property of literary, benevolent, charitable, and scientific institutions incorporated within the Commonwealth, and the real estate belonging to such institutions and occupied by them or their officers, for which they were incorporated,"<sup>1</sup> are exempt from taxation.

### Summary.

Harvard:

|                                         |         |              |
|-----------------------------------------|---------|--------------|
| Land appropriations (about) .....       | acres.. | 46,000       |
| Money appropriations (about) .....      |         | \$549,793.72 |
| Amherst College, appropriations .....   |         | 52,500.00    |
| Williams College, appropriations .....  |         | 187,500.00   |
| Agricultural College .....              |         | 540,575.49   |
| Institute of Technology .....           |         | 300,000.00   |
| Museum of Zoology (Harvard) .....       |         | 235,000.00   |
| Total appropriations by the State ..... |         | 1,764,368.98 |

### CONNECTICUT.

The history of early education in Connecticut presents the same self-sacrifice and devotion to the cause of learning that characterized the people of Massachusetts Bay. An historic branch of this colony, Connecticut followed the same general plan of education in providing for the system of local town schools and academies, and in supporting the college at Cambridge. But we find, after the founding of Yale in 1703, that while the system of local schools was continued with little change the greater part of the private and all of the public support was withdrawn from Harvard and given to the home school, which was finally located at New Haven. The Court of Connecticut pursued the same policy with regard to the support of Yale College that Massachusetts had previously followed in relation to Harvard, viz, by aiding the enterprise by means of grants of land and money, by protecting the property and making it exempt from taxation, and by favoring those engaged in the educational work.

Although the government of the college was under the immediate control of the General Assembly, whose members appointed the board of trustees, yet the Assembly or Court considered Yale a subject of legislation, and if not an organic part of the system of State, yet as an institution essential to the welfare of all, and one which they were in duty bound to support.

"The essential feature of this legislation as well of the whole history of our schools and colleges shows that the fathers of this colony realized the paramount duty of aiding the work of education. They can

<sup>1</sup> Revised Statutes, Chap. II, sec. 5, Title III.

**somewhat near, but of course did not grasp, the far more extensive work of supplying fully the needs of the people in establishing schools; and they came also somewhat near, but did not entirely understand, the duty of enforcing by universal law the use of opportunities of education by everybody."**<sup>1</sup>

It is surprising to see how readily in those days of poverty and self-denial the early assemblies, the representatives of the people, came to the support of institutions devoted to learning and culture. So cheerfully did the Assembly respond to the frequent memorials of the trustees of Yale that President Dwight was enabled to say, a century after its foundation, "You are to be informed that Yale College has never received any considerable benefactions except from the Legislature of Connecticut."<sup>2</sup> And in speaking of the board of trustees, who had almost entire control, he said, "Their acts, however, are to be laid before the Legislature as often as required, and may be repealed and disallowed whenever it shall think proper."<sup>3</sup>

#### EARLY LEGISLATION.

We find in the early annals relating to education in Connecticut the ruling of the Court concerning the support of students at Harvard. Rev. Mr. Shepard appeared before the commissioners and requested them to consider "some way of comfortable maintenance of that school of the Prophets which now is," and further suggested: "If it were commanded by you, and left to the freedom of every family which is able and willing to give throughout the plantations, to give but a fourth part of a bushel of corn, or something equivalent thereto, and for this end, if every minister were desired to stir up the hearts of the people once in the fittest season of the year, to be freely enlarged therein, and one or two faithful men be appointed in every town to receive and seasonably send in what shall be thus given to them, it is conceded that no man could feel any aggrievance hereby; so it would be a comfortable provision for the diet of divers such students as may stand in need of some support and may be thought fit and worthy to be continued a fit season therein."

#### SUPPORT OF HARVARD.

The commissioners approved the plan presented by Mr. Shepard, and reported the same to the Assembly of Connecticut. This body duly considered the matter, and finally passed the following law: "The proposition concerning maintenance of scholars at Cambridge made by the commissioners is confirmed, and it is ordered that two men shall be appointed in every town within this jurisdiction who shall demand what every family will give, and the same to be gathered and brought

<sup>1</sup>Chas. D. Hine, Secretary of the State Board Education, Connecticut.

<sup>2</sup>Dwight's N. A. England, 168.

<sup>3</sup>*Ibid.*, 150.

into some room in March. This shall be continued yearly as it shall be considered by the commissioners."<sup>1</sup>

Nine years later, in 1653, the General Assembly granted during the November session<sup>2</sup> the sum of twenty pounds for a fellowship in Harvard College.

#### EDUCATION IN TOWNS.

Earlier than this, however, the towns of Connecticut showed an interest in local education.<sup>3</sup> Hartford, settled in 1638, and New Haven, a year later, both made the subject of public schools a part of municipal legislation. The code of laws instituted by the Court of Connecticut concerning education is essentially the same as that adopted by Massachusetts, and reads thus: "It is ordered by the Court and authority thereof, that the selectment of every town in the several precincts and quarters where they dwell shall have a vigilant eye over their brethren etc.," to see that their children and servants do not grow up in ignorance.<sup>4</sup> Other laws for the instruction of children follow in this code.

In May, 1678, the following action was taken: "This Court now see cause to order that every town, when the Lord shall have increased their numbers to thirty families, they shall maintain a school to teach children to read and write." Prior to this, in 1665, a town of one hundred householders was to set up and maintain a grammar school, and subsequently the Court ordered (1671-72) that a grammar school be established in each of the four county towns of Hartford, New Haven, New London, and Fairfield. These schools were afterward endowed by the Court with six hundred acres of land each for their support.<sup>5</sup>

A fine of five pounds, which was afterward increased to ten, was imposed on every town not complying with the law in keeping a grammar school. The grammar schools of Hartford and New Haven were made free and of a higher grade by the action of the Court of 1690, and we find that the latter school early attained celebrity, under Master Cheever, who maintained it from 1638 to 1649 as a school in which Latin, Greek, and Hebrew were taught, to fit young men for "ye universitie." "The town paid twenty pounds a year to Mr. Ezekiel Cheever for two or three years at first, but in August, 1644, it was enlarged to thirty pounds a year, and so continueth."

The General Court favored this class of schools as the supporters of the University. In 1684 the Legislature passed the following act: "For the encouragement of learning and promoting public concernments, it is ordered by this Court that all such houses and lands used for school, church, or charitable purposes be exempted from taxation."<sup>6</sup> Two years thereafter another act provided that the surplus money in the treasury be distributed to the support of grammar schools.<sup>7</sup>

<sup>1</sup> Connecticut Colonial Records, I, 112.  
Trumbull.

<sup>2</sup> *Ibid.*

<sup>3</sup> *Ibid.*, II, 250.

<sup>4</sup> Code of Laws, I, 520. Trumbull

<sup>5</sup> Conn. Col. Rec, III, 176. Trumbull

<sup>6</sup> *Ibid.*, Oct., 1684.

<sup>7</sup> *Ibid.*, 224.

**This legislation in respect to grammar schools indicates the generous tendency of the public spirit and the attitude of the people of Connecticut, but the crowning work of the State is seen in its able support of Yale College, now Yale University. This venerable institution, from the time of its founding, has been the central power in the education of the State and has ever been her pride and her glory. Its influence has not only permeated every section of Connecticut, but it has shed its rays of light upon other States less fortunately provided with the advantages of higher education.**

The reform of 1701 established in Connecticut a complete system of education, which was an embodiment of previous acts of the Assembly extended and enlarged. The system embraced an obligation on the part of parents and guardians to educate their children and apprentices at least to the extent that they might be able to read "the holy word of God and the good laws of the colony." The new law also provided a tax of forty shillings on every thousand pounds of the lists of estates, which tax was collected in every town with the annual provincial tax, and was payable proportionally to those towns only which should establish their schools according to law. A town with seventy families and over must keep a school open at least six months in the year. In 1702 this law was changed so that a town of seventy families or over should keep a school open eleven months in a year, and a town of less than said number of families must keep a school for at least six months in the year to comply with the law, obtain State aid, and be free from fines. The grammar schools maintained in the four county towns were still to be continued to fit youth for college, and provision was also made in this educational system for the religious instruction of the Indians. But the most important regulation, and the one which concerns us chiefly, was the authorization of a "collegiate school," as it relates directly to the subject of higher education.

#### FOUNDING OF YALE COLLEGE.

**A truly significant event in the history of education at this period was the founding of Yale College. For sixty years Harvard had been the only school for higher education in New England. The people of Connecticut desired a school nearer home, especially for the training of their ministers. The first movement in the enterprise was made by three ministers, respectively of the towns of New Haven, Milford, and Branford.**

**"Ten ministers, nine of them being graduates of Harvard, met at Branford, and made a contribution from their libraries of about forty volumes in toto for the foundation of the college."<sup>1</sup> A nucleus being thus formed, other donations of books were made, and the General Court granted articles of incorporation. It was in 1700 that the act**

<sup>1</sup> Polley : History of New England, 371.

was passed, which was to bear rich fruit, "for the founding and suitably endowing and ordering a collegiate school . . . wherein the youth may be instructed in the arts and sciences, who, through the blessing of Almighty God, may be fitted for public employment both in church and in state."<sup>1</sup> The charter created a body of trustees, not to be more than eleven nor fewer than seven, all to be clergymen and at least forty years of age. The court endowed this college of Connecticut with an annual grant of one hundred and twenty pounds current money, which at that time was equivalent to sixty pounds sterling. This was subject to discontinuance at the will of the court, and it was granted that the college might hold property not exceeding the value of five hundred pounds annual income.<sup>2</sup>

The Governor and council gave a formal approval of the application of the board of trustees to citizens for pecuniary aid,<sup>3</sup> and in the session of October, 1703, the General Court passed an act freeing its students from military service and from the payment of taxes.<sup>4</sup> Subsequently an act was passed as follows: "This Assembly allow unto the reverend trustees sent for by this Assembly five shillings per diem during their attendance."<sup>5</sup>

Notwithstanding this favorable beginning of what has proved to be a great institution, the college of Connecticut was destined to pass through a period of doubtful existence. "For nearly twenty years," says Palfrey, "the college of Connecticut had continued to be an unsatisfactory experiment. While the rector taught some youth at Milford, and two tutors had other pupils at Saybrook, and the few scores of books which had been obtained for a library were divided between the two places, there was small prospect of the results for which institutions of learning are created."<sup>6</sup> The chief cause of this failure was the contention of the different towns for the university seat. The desire for local self-government, stimulated by local pride and local jealousy, has prevented the establishment of many excellent institutions in the United States. A glance at our educational history will suffice to show how this lack of united effort has naturally led to the opening of many superfluous schools of third and even fourth grade, and has at the same time prevented the growth of greater institutions with permanent endowments and first class facilities. It is evident that so long as the important question of location remained undecided there could be but little to encourage private donations. The most considerable sum given to Connecticut College during the early period was four hundred pounds sterling, donated by Elihu Yale.<sup>7</sup> This was so far in excess of any other gift received, that the college name was changed by the order of the court and in honor of this generous benefactor to Yale.

<sup>1</sup> Col. Rec., IV, 363, Palfrey.

<sup>2</sup> *Ibid.*

<sup>3</sup> *Ibid.*, 471.

<sup>4</sup> *Ibid.*, 440.

<sup>5</sup> *Ibid.*, V, 39.

<sup>6</sup> Palfrey: *History of New England*, 471.

<sup>7</sup> *Ibid.*, IV, 477.

It was a day of small things when a sum like this could earn so great a name. Meanwhile the strife as to location continued; doubtless the Assembly was deserving of censure for not promptly deciding where the college should be. It seems that after settling it at Saybrook they passed the following in May, 1718: "Considering the great dissatisfaction of the country in general, do conclude, in order to (the college) flourishing and having the support of the Government, it must be settled somewhere near the Connecticut River."<sup>1</sup> The grant of £120 per annum was reduced to one hundred pounds, and was to be drawn in bills of credit for the time being in favor of the three towns of Saybrook, Wethersfield, and New Haven, which were contending for the location of the seat of learning. In the meantime the trustees were authorized to go on with the construction of the college at New Haven.

#### COLLEGE LOCATED AT NEW HAVEN.

New Haven raised the sum of seven hundred pounds for an endowment, thus offering by far the greatest inducement, and the Legislature finally decided to locate the college at that place.<sup>2</sup> To forward the enterprise of building, the Assembly gave two hundred and fifty acres of land, which sold for the same number of pounds (£250).<sup>3</sup> and they also granted one hundred pounds in current money.<sup>4</sup> A building was at once erected with these funds. Saybrook refused to give up the college books or yield to the order of the Assembly concerning the location. But after some difficulty, accompanied with the loss of books, the matter was finally decided in favor of New Haven.

After the college was definitely settled at New Haven and buildings were begun, the General Assembly had little to do with the internal affairs of the college. Its chief work consisted in granting funds to supply the needs of the institution in response to the frequent memorials of the trustees. In 1715 a grant of five hundred pounds was ordered

<sup>1</sup> Conn. Col. Rec., V, 30, 38.

<sup>2</sup> *Ibid.*, VI, 30. "Another matter of historical interest which I presume has not escaped your attention is the question why the college was located at New Haven. You say, I believe, that it was due to the large donation or gift from that town, viz: seven hundred pounds. This probably had something to do with it, but why should even this take the college to New Haven, a comparatively unimportant, uninfluential, and poor town, remote and off the line of travel, when Wethersfield and Saybrook, both more fit for the special purposes of the college, were passed by? I suspect, and there is, I am told by Mr. Hoadly, of our State library, some evidence that the then Governor, Salmonell, was influential in this. He was a thrifty man and had secured large tracts of land near New Haven. It would enhance the value of his land, and perhaps bring settlers, if the college were there established. You will find in one of the laws about that period that New Haven is referred to as 'remote.' You will note that Saybrook was on the sea-shore and river, and also on the line of travel from the center, and that the population and the prospective students were in New London County and Hartford County rather than near New Haven."

<sup>3</sup> Palfrey: Hist. New Eng., IV, 477.

<sup>4</sup> Conn. Col. Rec., VI, 84 H.



by the Assembly, to be paid the next year from money to be realized from Massachusetts's payment for her encroachment on the boundaries of Connecticut.<sup>1</sup> Three years later the sum of three hundred pounds was granted from the sale of lands, to be paid in annual installments of forty pounds each, for seven years.<sup>2</sup> Lands in the town of Stafford were ordered to be sold by a committee appointed for that purpose, and the proceeds paid to Yale.

By an act of October, 1721, it was "provided also that what shall be gained by the impost on rum for two years next coming shall be applied to building of a rector's house at Yale." The duty was fixed by this act at four pence per gallon on all imports of rum. In October, 1727, the income on rum for one year was to be given to Yale. Two years later a grant of eighty pounds annually for two years, 1729-30, was made to Yale in addition to the usual allowance.<sup>3</sup> In 1730 this special annual allowance was increased to one hundred pounds, and this was continued by separate acts of the Assembly until 1741.<sup>4</sup>

In 1732 the largest grant of land for the benefit of Yale was given in the following act: "This Assembly do grant and order that in each of the five new townships lately laid out east of the Ousatanuck River there shall be laid out in one entire piece, three hundred acres of land . . . granted and confirmed to the trustees of said college."<sup>5</sup>

#### PECULIAR LEGISLATION.

As an illustration of the peculiar sense of justice concerning the duties of the State to the college and the towns, the payment of damages by the State for the removal of a rector from a parish stands pre-eminent. Mr. Williams, rector of Newington, was invited in 1726 to become rector at Yale. He accepted the invitation, and the injured people of Newington applied to the trustees of Yale for damages, and these in turn applied to the Legislature. The Legislature granted the sum of one hundred pounds to the people of Newington to reimburse them "for the sum spent in settling him among them."<sup>6</sup> Again, in May, 1740, Yale College was without a rector, and a suitable one was found in Mr. Thomas Clapp, rector of Windham. After his election the Windham people sent in a plea for three hundred and ten pounds for alleged damages sustained by them in the removal. The matter being referred by the trustees to the General Court, the full amount was ordered paid out of the public treasury.<sup>7</sup>

In the October session of 1741 thirty pounds were ordered to be paid annually for three years for the new "tenour" at Yale. A bill for repairs on the rector's house was ordered to be paid out of the public treasury; and it is noticeable that nearly every one of these "acts" in favor

<sup>1</sup> Dexter: History of Yale College.

<sup>2</sup> Conn. Col. Rec., V, 125.

<sup>3</sup> *Ibid.*, 223, Hoadly.

<sup>4</sup> *Ibid.*, VI, 302, 473, 523.

<sup>5</sup> *Ibid.*, 412.

<sup>6</sup> *Ibid.*, 24.

<sup>7</sup> *Ibid.*, 303.

of Yale was the result of a memorial of the trustees stating the needy condition of the college and asking for aid. It seems that a grant had been made in 1745 of which no record is to be found at hand, but it was paid in 1751 and 1752 as follows: £116 30s. 6d. were ordered paid in 1751 in lieu of the grant of 1745, and £114 6s. in 1752 in lieu of the same grant, making in all a sum of £231 16s. 6d. The college was further aided in 1751 by the grant of certain bills of credit, amounting to £7,764 17s. 3d., of sundry persons to the president and trustees of Yale for building the "college house."

In the following year (1752-53) the usual grant of £100 was increased to £228 10s.

#### THE COLONY'S GENEROSITY TO YALE.

Thus, says Palfrey, "the colony continued to be generous to Yale College. The accustomed annual gift of a hundred pounds to that institution was first doubled (October 8, 1735), then tripled (October 8, 1741), then further increased." No change of any importance could be introduced without the formal sanction of the General Court. The time having arrived when a chair in theology became a necessity, the Assembly ordained as follows: "Whereas one principal end proposed in erecting and supporting Yale College, in New Haven, was to supply the churches of this colony with a learned, pious, and orthodox ministry, etc.," they recommend a "subscription for founding a professor of divinity at Yale College."

This liberality of the State of Connecticut toward Yale College has extended down to the present century, and is realized at the present time.

In 1792, and by supplementary act in 1796, the Assembly granted the sum of forty thousand dollars,<sup>1</sup> which was followed in 1814 by a grant of twenty thousand dollars,<sup>2</sup> and subsequently, in 1831, by another of seven thousand dollars.<sup>3</sup>

It would be difficult to estimate the amount of assistance thus given by the State of Connecticut to Yale College in money value; nor is it possible to determine the value of the gift of even a small sum at the right time to relieve an institution from embarrassment. But when we consider the great benefit which the other institutions of Connecticut have received from Yale, it is so far in excess of the investments made that these sink into comparative insignificance.

#### SHEFFIELD SCIENTIFIC SCHOOL.

The Sheffield Scientific School was begun in 1847. In the previous year (1846) the corporation of Yale College made provision for instruction in agricultural chemistry and chemistry applied to the arts, and in 1852 a professor of engineering was appointed. These chairs were

<sup>1</sup> Dexter: History of Yale, 53.

<sup>2</sup> *Ibid.*, 51.

<sup>3</sup> *Ibid.*, 60.

without endowment, and yet the number of students increased, until there were, in 1856, over three hundred and fifty in these departments. A proposed plan for a complete school of science was published in 1856, and this plan was adopted.<sup>1</sup>

In 1860 a convenient building was given by Joseph E. Sheffield, and to this he added a considerable endowment.<sup>2</sup> In recognition of these generous gifts the school was named after Mr. Sheffield, who afterward made still other donations.

In 1864 the Connecticut Legislature gave this school the proceeds of the United States land grant of 1862. This grant consisted of one hundred and eighty thousand acres of land scrip, which was sold at seventy-five cents per acre, yielding about \$135,000. The interest received in 1874 from invested funds amounted to \$6,386.24. This sum was wholly given to scholarships, thus enabling a body of poor young men throughout the State to obtain a scientific education.

The State aid was in this instance well applied to a growing institution, which by its endowment, government, and achievement ranks high as a scientific school.

It was a very wise measure to place the State funds in the form of scholarships, for the tuition is so high as to bar out many who but for this assistance would be deprived of the power to make themselves useful to the State and society at large. Tuition fees are one hundred and fifty dollars, with an additional fee of seventy dollars to special students in chemistry, while a charge of five dollars is made for permission to use the college reading room and gymnasium.<sup>3</sup>

At the legislative session of 1887, an annual grant of eight thousand dollars was made to the Agricultural Experiment Station at New Haven.<sup>4</sup> Twenty five thousand dollars had been previously spent in fitting up the station.

#### STORRS AGRICULTURAL SCHOOL.

This institution was founded with a gift of one hundred and seventy acres of land from Mr. Augustus Storrs, and to this donation Mr. Charles Storrs added six thousand dollars. This together with the State bounty has stocked the farm and equipped the school.

Only boys whose parents are natives of the State of Connecticut are eligible to membership in the institution.

The General Assembly established the school by an act of 1881, and provided for six trustees, who were to have entire control. It was also provided by section five of this act that five thousand dollars should be paid annually for three years toward the support of the school.

<sup>1</sup> *Annals of the Scientific School*, 1856, 1.

<sup>2</sup> *Programme of the Sheffield Scientific School*, 1873-74, 15.

<sup>3</sup> *Ibid.*, 20.

<sup>4</sup> Charles D. Hine, Secretary State Board of Education. Letter of July 20, 1887.

At the session of the Legislature in 1887 an appropriation of eight thousand dollars per annum was granted the Storrs Agricultural School.<sup>1</sup>

## SUMMARY OF GRANTS.

|                                                                          |                 |
|--------------------------------------------------------------------------|-----------------|
| Harvard Scholarship, £20 per annum, (to Harvard) 1653-1700 .....         |                 |
| General Court grant, £120 <sup>2</sup> per annum, charter, 1700-18 ..... | £2,160          |
| General Court grant, £100 per annum, charter, 1718-41 .....              | £2,300          |
| Grant by the town of New Haven, 1718 .....                               | £700            |
| Grants, General Court, 1718 .....                                        | £750            |
| Grants, General Court, (land) 1715 .....                                 | £500            |
| Tax on rum, one penny per gallon .....                                   |                 |
| Grant of £50 per annum for two years, 1720-30 .....                      | £160            |
| Grant of £100 per annum for eleven years, 1730-41 .....                  | £1,100          |
| Land grants on the Ousatunnuck, 1,500 acres .....                        |                 |
| Grant on account of ministers, 1726 and 1740 .....                       | £410            |
| Grant of £30 for three years annually, 1741 .....                        | £90             |
| Grant of £200 per annum, 1741-1888 .....                                 |                 |
| Grant for building, 1745 .....                                           | £231 6s. 6d.    |
| Grant of bills of credit .....                                           | £7,764 17s. 3d. |
| Increase of annual grant .....                                           | £128            |
| Appropriation of General Assembly, 1792 and 1796 .....                   | \$40,629        |
| Appropriation of General Assembly, 1811 .....                            | \$20,000        |
| Appropriation of General Assembly, 1831 .....                            | \$7,000         |
| Total grants to Yale, (approximate) .....                                | \$122,676       |
| Appropriation Sheffield Scientific School, (U. S. grant) 1902 .....      | \$135,000       |
| Annual appropriation Sheffield Scientific School, 1887 .....             | \$8,000         |
| Appropriation to Storrs Agricultural School .....                        | \$15,000        |
| Annual appropriation, Storrs Agricultural School, 1887 .....             | \$8,000         |
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## RHODE ISLAND

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In its settlement and early history Rhode Island differs in many respects from the other New England Colonies, and these differences are observed in the development of the principal institutions of the State. The Massachusetts Colonies were composed of a homogeneous people, with definite religious beliefs and definite civil organizations. There was a positive belief in religion and politics, and men were forced to conform to established tenets and laws or their presence was not welcomed at the colonies. The Connecticut colonies were direct off-

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shoots of the Massachusetts colonies, and adopted similar policies in all matters pertaining to the control of the social organism. But Rhode Island, founded by a dissenter from these views, adopted a liberal policy in religion and government. All persons, of whatsoever creed, were welcomed to the new colony, and there sprang up, as a consequence, various beliefs in regard to government and religion. Whatever may be said about the motives entertained by the colonists of New England for settling in this new land, it must ever be held as a first principle that religion was the great organizer; and wherever it was strongest the government was soonest organized and most exact in its execution.

As compared with Massachusetts, the institutions of Rhode Island were slow in developing. Nowhere is the contrast more observable than in the matter of public education. The schools of Rhode Island fell almost a hundred years behind the progress of those of the adjacent colonies.

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The colonial schools of Rhode Island were supported entirely by towns or by private enterprise. The central government considered it no part of its legitimate function to look after the general education. The first school was held at Newport in 1640, by Rev. Robert Lenthal, who had left Massachusetts on account of certain ecclesiastical troubles, "and August 20, Mr. Lenthal was, by vote, called to keep a public school for the learning of youth; and for his encouragement there was granted to him and his heirs one hundred acres of land, and four more for an house-lot; it was also voted 'that one hundred acres should be laid forth and appropriated for a school, for encouragement of the poorer sort to train up their youth in learning, and Mr. Robert Lenthal, while he continues to teach school, is to have the benefit thereof.' But this gentleman did not tarry very long; I find him gone to England the next year but one."<sup>1</sup>

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The majority of these colonial schools were not equal to the grammar schools of Massachusetts and Connecticut of that day. From all we can learn of the early period, and from the subsequent struggle to establish a public school system it must be inferred that the government was not active and persistent in aiding education of any sort, while in the country districts of Massachusetts, and near the Rhode Island border, we find the schools in a prosperous condition. There was one at Barrington, then a part of Swansea, Mass., which was maintained "for the teaching of grammar, rhetoric, arithmetic, and the tongues of Latin, Greek, and Hebrew, also to teach English, and to write."<sup>3</sup>

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University, and the income goes toward paying the tuition of a certain number of State students, who are nominated by the Legislature.

Another item should be mentioned. The charter of the institution originally exempted the property of its professors; but now, by amendment of the charter, it exempts professorial property to the extent of ten thousand dollars for each professor.<sup>1</sup>

#### NEW HAMPSHIRE.

While Harvard was the only literary institution in the country, the towns of New Hampshire contributed liberally for its support and were desirous of promoting its interests. As early as the year 1669, at the time of soliciting funds for a new building, the inhabitants of Portsmouth subscribed sixty pounds annually for a term of seven years, and at the same time and for the same purpose Dover gave thirty-two pounds and Exeter ten pounds.<sup>2</sup>

Not all of the support of the colony was given to the central institution, for we find that towns very early began grammar schools of their own.

#### TOWN SCHOOLS.

In fact, the town system of educational support was particularly noteworthy in New Hampshire, and so remains until this day. "The policy of the State has been to leave in the hands of the family and the neighborhood the main share of the work in educating the child. This doctrine was in harmony with the active and liberty-loving principles of our ancestors. Next to the parent and citizen in the work of education, the State recognizes the town as the proper agency for maintaining schools."<sup>3</sup>

Thus, from the Dover town records it is learned that, "at a public Town Meeting held the 5:2 mo 58 (1658), It is agreed that Twenty pounds per annum, shall be yearly rayzed for the mayntenance of a School-master in the Town of Dover."<sup>4</sup>

The General Court of the province of New Hampshire very early provided that each town should have a school-master and a minister of the Gospel, and pay them by a rate.<sup>5</sup> The weight of responsibility was thrown upon the towns. Again, "An act for the settlement and support of grammar schools,"<sup>6</sup> passed the 5th of George I (1719), made it obligatory on each town of fifty householders to provide a school, and each town of one hundred freeholders a Latin school; the "select men" were to raise the money for the support of the schools by taxation, and any town failing to comply was fined twenty pounds.

<sup>1</sup> President E. G. Robinson, Brown University.

<sup>2</sup> Nathaniel Adams: *Annals of Portsmouth*, 50.

<sup>3</sup> *State Report*, 1875-76, 226.

<sup>4</sup> Smith: *Dartmouth College*, I.

<sup>5</sup> *Laws of the Province*, I, 88.

<sup>6</sup> *Ibid.*, 120.

**These laws were almost identical with those of the General Court of Massachusetts.** It is said that "when New Hampshire became a province in 1647, the laws of Massachusetts were copied, but only existed on the statute books, never being enforced."<sup>1</sup> In 1789 the Legislature repealed all previous acts, and authorized English grammar schools for teaching reading, and writing, and arithmetic, "provided that in shire and half-shire, grammar schools for teaching Latin and Greek shall be provided."

Prior to this act the "form of government" adopted in 1784 had made a firm declaration in favor of the encouragement of learning. It asserts that "Knowledge and learning, generally diffused through a community, being essential to the preservation of a free government; \* \* \* it shall be the duty of the legislators and magistrates in all future periods of this Government to cherish the interest of literature and the sciences, and all seminaries and public schools, &c."

These provisions of the law cited above still threw the responsibility on the towns, and the only instance where education of an advanced grade received the support of the State is that of the assistance given to Dartmouth College.

## DARTMOUTH COLLEGE.

"The germ of Dartmouth College was a deep-seated and long-cherished desire of the foremost of its founders to elevate the Indian Race in America."<sup>2</sup> In this respect it differs but little from the first foundations of Harvard and the first college in Virginia, except that the first school, of which Dartmouth is the successor, was composed of Indian youth. The school was founded as a private school and a private charity, but was forced to appeal to the State for assistance in order to preserve its existence.

The initiative step toward the founding of a college in New Hampshire was taken, as in the case of the founding of Yale, by an association of ministers. As early as 1758 a convention of Congregational ministers, assembled in Somersworth, framed a petition to Governor Wentworth for a college in the province of New Hampshire, "to serve the government and religion by laying a foundation for the best instruction of youth."<sup>3</sup>

It was urged that the distance from any seats of learning rendered the education of youth exceedingly difficult, and it was hoped that by means of interest among the people and "some favor from the Government" sufficient funds could be raised "for erecting and carrying on an academy or college within this province, without prejudice to any other seminary in neighboring colonies." The Governor failed to grant the petition, and subsequently the matter of education was referred to a committee for consideration until the convention of ministers in 1762

<sup>1</sup> State Report, 1876, 295.

<sup>2</sup> Smith, I.

<sup>3</sup> *Ibid.*, 16.



endorsed the work of Mr. Wheelock, and transferred their zeal to the support of the Indian school, out of which sprung the beginning of the college.

#### THE INDIAN SCHOOL.

The Rev. Eleazer Wheelock, residing in Lebanon, Conn., was led to meditate upon the subject of his means of support, as his people through lack of means failed to provide bountifully. It occurred to him that if they furnished him with but half a living they were entitled to no more than half of his labors, and he consequently resolved to devote a portion of his time to the education of Indian youth. He at once began his work, which was aided by subscriptions from friends in America and England. The number of pupils, beginning with two, soon rose to thirty, and the Indian charity school was formed. In 1761 the General Court of Massachusetts recognized his efforts, and voted that he should be allowed to take under his charge six pupils from the six nations for education, boarding, and clothing, for which he was to receive twelve pounds per annum for each child, to be paid from the public treasury. In the following year the Legislature of New Hampshire granted fifty pounds sterling per annum for five years as aid to the school. However, this was not paid after the first, or possibly after the second year.<sup>1</sup>

But a growing school and an empty treasury caused Mr. Wheelock to send two agents to England to solicit funds. Accordingly Rev. Mr. Whitaker and Mr. Samson Occum, an Indian preacher, were sent for that purpose in 1765.

A live Indian preacher of a good degree of intelligence, speaking in England, stirred the hearts of the people, and a large sum of money was consequently raised by the agents for the Indian schools, the King being among the chief contributors.<sup>2</sup>

The favorable results of this mission abroad caused Mr. Wheelock to entertain designs for a college. He succeeded in obtaining a charter, granted in 1769. The problem of determining a site for the new school next occupied his attention. Liberal inducements were held out by Connecticut, Pennsylvania, and New Hampshire. It was finally decided after due deliberation to locate the college at Hanover in New Hampshire, and consequently the Indian school was removed there in 1769. The plan for the education of the Indians was embodied in the charter, and the Indian charity school was the basis of the institution chartered. The "laudable design of spreading Christian knowledge among the savages of the American wilderness," and that "the best means of education be established in our province of New Hampshire."<sup>3</sup>

<sup>1</sup> See ch. 172.

<sup>2</sup> Dwight, *Travels in New England*, II, 100. See also Sparks' *Life of John Ledg* ch. 1.

<sup>3</sup> From a copy of the charter: Smith, 459.

were given as the reasons for granting the charter of Dartmouth College.

The original design of educating Indians and missionaries to the Indians was frustrated.<sup>1</sup> For three years after the founding only a small number of missionaries and persons destined as candidates for this employment were sent among the Indians; afterwards all efforts ceased in this behalf.

The inhabitants of Hanover presented the college with twelve hundred acres of valuable land; the State of New Hampshire endowed it with about seventy-eight thousand acres more,<sup>2</sup> in several successive grants, the most important of which was made in January, 1789, when the Legislature gave a tract of four thousand two hundred acres located above Stewartstown.<sup>3</sup> By the terms of this grant the Governor and Council of the State for the time being were incorporated with the trustees for the purpose of acting with them in the management of all funds granted to the college by the State.<sup>4</sup>

Other grants of a moderate amount were made by the State.

The annual revenue of Dartmouth was, in 1793, from tuition about two thousand dollars; from rent of lands about five hundred dollars. It was expected by contracts made in the same year that the income from rents would be one thousand five hundred dollars in 1797, and two thousand one hundred and sixty-six dollars in 1803.<sup>5</sup>

One of the most remarkable grants on record is that made by the Legislature of Vermont in 1785-86. Mr. Wheelock appeared before that body at this time and presented the case of the college; as a result of his pleading the Legislature granted to the college the entire township of Wheelock—one-half for the school and one-half for the college.<sup>6</sup> It was this grant which led Daniel Webster to remark that "The State of Vermont is a principal donor to Dartmouth College."<sup>7</sup>

In 1807, Dr. Wheelock appeared before the General Court and appealed for aid, representing to the Legislature the conditions and needs of the college. As a result of his visit the trustees of the college were granted a township of land six miles square lying on the border of the district of Maine.<sup>8</sup>

#### THE COLLEGE OF AGRICULTURE AND THE MECHANIC ARTS.

The proceeds arising from the sale of the land scrip (one hundred and fifty thousand acres) assigned to New Hampshire were appropriated to the founding of the New Hampshire College of Agriculture and the Mechanic Arts, in connection with Dartmouth College at Hanover.

The act making this appropriation was approved July 7, 1866, and before the close of the following year the scrip was sold at an average

<sup>1</sup> Dwight, II, 103.

<sup>4</sup> Dwight, II, 103.

<sup>6</sup> Webster's Works, V, 4-2.

<sup>2</sup> *Ibid.*, 101.

<sup>3</sup> *Ibid.*, 102.

<sup>7</sup> Smith, 83.

<sup>8</sup> Smith, 80.

price of fifty-three and one-third cents per acre, yielding eighty thousand dollars, which were invested in six per cent. State bonds.

The general government of the college was vested in nine trustees, five of whom are appointed by the Governor with the advice of the Council, and four are taken from the trustees of Dartmouth College.<sup>1</sup>

The new college thus obtained the use of the libraries and the appliances of Dartmouth, together with the special advantages of the Thayer School of Architecture and Civil Engineering and the Chandler Scientific Department.

The Legislature granted the sum of five thousand dollars for buildings, and later granted twelve thousand dollars for an experimental farm and buildings thereon, on the condition that Hon. John Conant give twelve thousand dollars for the same purpose.

The sum of ten thousand dollars, five thousand for each of two years, 1883 and 1884-85, was voted by the General Assembly of New Hampshire to pay the tuition of indigent students. By this same act it was provided that any resident student of the State is entitled to have his tuition paid by complying with certain conditions.<sup>2</sup>

Other appropriations have been made, sufficient to make the entire amount granted by the State fifty-four thousand dollars; during the same period the college has received \$63,400 in benefactions—that is, the Congressional grant of eighty thousand dollars stimulated additional gifts aggregating \$117,400.

#### SUMMARY OF GRANTS.<sup>3</sup>

##### *Dartmouth College.*

##### Appropriations by the royal province of New Hampshire:

|                                                                |            |
|----------------------------------------------------------------|------------|
| May 27, 1773, for a new building, £500 (lawful money) .....    | \$1,000.00 |
| April 5, 1777, for the subsistence of the president, £60 ..... | 200.00     |
| Total .....                                                    | 1,200.00   |

##### Appropriations by the State of New Hampshire:

|                                                              |           |
|--------------------------------------------------------------|-----------|
| June, 1790, for general use .....                            | \$900     |
| September 15, 1793, for education of indigent students ..... | 10,000    |
| Total .....                                                  | 10,900.00 |

##### For the medical department:

|                                  |       |
|----------------------------------|-------|
| June, 1861, for appliances ..... | 600   |
| June, 1862, for building .....   | 4,937 |

Total .....

5,537.00

Total money appropriations to Dartmouth exclusive of those made to the College of Agriculture .....

35,000.00

<sup>1</sup> Laws of New Hampshire, 1866, chap. 421b.

<sup>2</sup> *Ibid.*, 1793, chap. 116, p. 92.

<sup>3</sup> The writer is indebted to the acting president of the University of Vermont for many important points in this summary.

*Agricultural College.*

Total legislative appropriations to the New Hampshire College of Agriculture and the Mechanic Arts from 1839 to 1888, inclusive..... 71,900.00

Entire money grants ..... 106,931.66

*Land grants to Dartmouth.*

|                                                                           | Acres.         |
|---------------------------------------------------------------------------|----------------|
| By the Legislature of Vermont, June 24, 1785.....                         | 23,000         |
| By the Legislature of New Hampshire, February 5, 1789 .....               | 40,960         |
| By the Legislature of New Hampshire, June 18, 1807 .....                  | 23,040         |
| By the Legislature of New Hampshire, small grants at different times..... | 4,000          |
| <b>Total land grants .....</b>                                            | <b>101,000</b> |

## MAINE.

## EARLY SCHOOLS.

The Massachusetts system of schools extended in colonial times to the province of Maine, and the laws enacted by the General Court, or later by the Legislature of the parent State, remained in force in that province until the organization of Maine into a separate State.

The celebrated law<sup>1</sup> of 1642, requiring the selectmen to "have a vigilant eye over their brethren and neighbors" to see that their children and apprentices be taught to read, as well as the subsequent more general law of 1647, which required each town of fifty householders to sustain an elementary school, and each town of one hundred householders a "grammar school," obtained throughout the province of Maine.

Thus the condition of education in the province must be determined largely by the general laws enacted by the Court of Massachusetts. The revised laws of 1789 likewise extended to Maine, and were in force at the time of the adoption of the State Constitution in 1820.

Thus the old "grammar schools" of New England, and subsequently the "New England academies," were found among the educational institutions of Maine, and the endowment of Bowdoin College by the General Court completed the system.

When Maine was organized into a State, the responsibility of education was largely thrown upon the towns. Article VIII of the Constitution of Maine, adopted in 1820, provides for education as follows: "A general diffusion of the advantages of education being essential to the preservation of the rights and liberties of the people, to promote this important object, the Legislature are authorized, and it shall be their duty, to require the several towns to make suitable provision, at their own expense, for the support and maintenance of public schools, and it shall further be their duty to encourage and suitably endow, from time to time, as the circumstances of the people may authorize,

<sup>1</sup> See Massachusetts. No. 19, p. 39.

without endowment, and yet the number of students increased, until there were, in 1856, over three hundred and fifty in these departments. A proposed plan for a complete school of science was published in 1856, and this plan was adopted.<sup>1</sup>

In 1860 a convenient building was given by Joseph E. Sheffield, and to this he added a considerable endowment.<sup>2</sup> In recognition of these generous gifts the school was named after Mr. Sheffield, who afterward made still other donations.

In 1864 the Connecticut Legislature gave this school the proceeds of the United States land grant of 1862. This grant consisted of one hundred and eighty thousand acres of land scrip, which was sold at seventy-five cents per acre, yielding about \$135,000. The interest received in 1874 from invested funds amounted to \$6,386.24. This sum was wholly given to scholarships, thus enabling a body of poor young men throughout the State to obtain a scientific education.

The State aid was in this instance well applied to a growing institution, which by its endowment, government, and achievement ranks high as a scientific school.

It was a very wise measure to place the State funds in the form of scholarships, for the tuition is so high as to bar out many who but for this assistance would be deprived of the power to make themselves useful to the State and society at large. Tuition fees are one hundred and fifty dollars, with an additional fee of seventy dollars to special students in chemistry, while a charge of five dollars is made for permission to use the college reading room and gymnasium.<sup>3</sup>

At the legislative session of 1887, an annual grant of eight thousand dollars was made to the Agricultural Experiment Station at New Haven.<sup>4</sup> Twenty-five thousand dollars had been previously spent in fitting up the station.

#### STORRS AGRICULTURAL SCHOOL.

This institution was founded with a gift of one hundred and seventy acres of land from Mr. Augustus Storrs, and to this donation Mr. Charles Storrs added six thousand dollars. This together with the State bounty has stocked the farm and equipped the school.

Only boys whose parents are natives of the State of Connecticut are eligible to membership in the institution.

The General Assembly established the school by an act of 1881, and provided for six trustees, who were to have entire control. It was also provided by section five of this act that five thousand dollars should be paid annually for three years toward the support of the school.

<sup>1</sup> Plan for Scientific School, 1856, 1.

<sup>2</sup> Programme of the Sheffield Scientific School, 1873-74, 15.

<sup>3</sup> *Ibid.*, 29.

<sup>4</sup> Charles D. Hine, Secretary State Board of Education. Letter of July 30, 1887.

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## SUMMARY OF GRANTS.

|                                                                         |                 |
|-------------------------------------------------------------------------|-----------------|
| Harvard Scholarship, £20 per annum, (to Harvard) 1653-1700 .....        |                 |
| General Court grant, £120 <sup>2</sup> per annum, charter, 1700-18..... | £2,160          |
| General Court grant, £100 per annum, charter, 1718-41.....              | £2,300          |
| Grant by the town of New Haven, 1718.....                               | £700            |
| Grants, General Court, 1718.....                                        | £750            |
| Grants, General Court, (land) 1715.....                                 | £500            |
| Tax on rum, one penny per gallon.....                                   |                 |
| Grant of £80 per annum for two years, 1729-30.....                      | £160            |
| Grant of £100 per annum for eleven years, 1730-41.....                  | £1,100          |
| Land grants on the Ousatanuck, 1,500 acres.....                         |                 |
| Grant on account of ministers, 1726 and 1749.....                       | £410            |
| Grant of £30 for three years annually, 1741.....                        | £90             |
| Grant of £300 per annum, 1741-1888.....                                 |                 |
| Grant for building, 1745.....                                           | £231 6s. 6d.    |
| Grant of bills of credit.....                                           | £7,764 17s. 3d. |
| Increase of annual grant.....                                           | £128            |
| Appropriation of General Assembly, 1792 and 1796.....                   | \$40,629        |
| Appropriation of General Assembly, 1814.....                            | \$20,000        |
| Appropriation of General Assembly, 1831.....                            | \$7,000         |
| Total grants to Yale, (approximate).....                                | \$122,676       |
| Appropriation Sheffield Scientific School, (U. S. grant) 1862.....      | \$135,000       |
| Annual appropriation Sheffield Scientific School, 1887.....             | \$4,000         |
| Appropriation to Storrs Agricultural School.....                        | \$15,000        |
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<sup>2</sup>*Ibid.* <sup>3</sup>Annals of Providence, 515; Stockwell, 11.



University, and the income goes toward paying the tuition of a certain number of State students, who are nominated by the Legislature.

Another item should be mentioned. The charter of the institution originally exempted the property of its professors; but now, by amendment of the charter, it exempts professorial property to the extent of ten thousand dollars for each professor.<sup>1</sup>

#### NEW HAMPSHIRE.

While Harvard was the only literary institution in the country, the towns of New Hampshire contributed liberally for its support and were desirous of promoting its interests. As early as the year 1669, at the time of soliciting funds for a new building, the inhabitants of Portsmouth subscribed sixty pounds annually for a term of seven years, and at the same time and for the same purpose Dover gave thirty-two pounds and Exeter ten pounds.<sup>2</sup>

Not all of the support of the colony was given to the central institution, for we find that towns very early began grammar schools of their own.

#### TOWN SCHOOLS.

In fact, the town system of educational support was particularly noteworthy in New Hampshire, and so remains until this day. "The policy of the State has been to leave in the hands of the family and the neighborhood the main share of the work in educating the child. This doctrine was in harmony with the active and liberty-loving principles of our ancestors. Next to the parent and citizen in the work of education, the State recognizes the town as the proper agency for maintaining schools."

Thus, from the Dover town records it is learned that, "at a publique Town Meeting held the 5:2 mo 58 (1658), It is agreed that Twenty pounds per annum, shall be yearly rayzed for the mayntenance of a School-master in the Town of Dover."<sup>3</sup>

The General Court of the province of New Hampshire very early provided that each town should have a school-master and a minister of the Gospel, and pay them by a rate.<sup>4</sup> The weight of responsibility was thrown upon the towns. Again, "An act for the settlement and support of grammar schools,"<sup>5</sup> passed the 5th of George I (1719), made it obligatory on each town of fifty householders to provide a school, and each town of one hundred freeholders a Latin school; the "select men" were to raise the money for the support of the schools by taxation, any town failing to comply was fined twenty pounds.

<sup>1</sup> President E. G. Robinson, Brown University.

<sup>2</sup> Nathaniel Adams: *Annals of Portsmouth*, 50.

<sup>3</sup> *State Report*, 1575-76, 256.

<sup>4</sup> Smith: *Dartmouth College*;

<sup>5</sup> *Laws of the Province*, I, 88.

<sup>6</sup> *Ibid.*, 120.

These laws were almost identical with those of the General Court of Massachusetts. It is said that "when New Hampshire became a province in 1647, the laws of Massachusetts were copied, but only existed on the statute books, never being enforced."<sup>1</sup> In 1789 the Legislature repealed all previous acts, and authorized English grammar schools for teaching reading, and writing, and arithmetic, "provided that in shire and half-shire, grammar schools for teaching Latin and Greek shall be provided."

Prior to this act the "form of government" adopted in 1784 had made a firm declaration in favor of the encouragement of learning. It asserts that "Knowledge and learning, generally diffused through a community, being essential to the preservation of a free government; . . . it shall be the duty of the legislators and magistrates in all future periods of this Government to cherish the interest of literature and the sciences, and all seminaries and public schools, &c."

These provisions of the law cited above still threw the responsibility on the towns, and the only instance where education of an advanced grade received the support of the State is that of the assistance given to Dartmouth College.

## DARTMOUTH COLLEGE.

"The germ of Dartmouth College was a deep-seated and long-cherished desire of the foremost of its founders to elevate the Indian Race in America."<sup>2</sup> In this respect it differs but little from the first foundations of Harvard and the first college in Virginia, except that the first school, of which Dartmouth is the successor, was composed of Indian youth. The school was founded as a private school and a private charity, but was forced to appeal to the State for assistance in order to preserve its existence.

The initiative step toward the founding of a college in New Hampshire was taken, as in the case of the founding of Yale, by an association of ministers. As early as 1758 a convention of Congregational ministers, assembled in Somersworth, framed a petition to Governor Wentworth for a college in the province of New Hampshire, "to serve the government and religion by laying a foundation for the best instruction of youth."

It was urged that the distance from any seats of learning rendered the education of youth exceedingly difficult, and it was hoped that by means of interest among the people and "some favor from the Government" sufficient funds could be raised "for erecting and carrying on an academy or college within this province, without prejudice to any other seminary in neighboring colonies." The Governor failed to grant the petition, and subsequently the matter of education was referred to a committee for consideration until the convention of ministers in 1762

<sup>1</sup> State Report, 1876, 225.

<sup>2</sup> Smith, I.

*Ibid.*, 16.

endorsed the work of Mr. Wheelock, and transferred their zeal to the support of the Indian school, out of which sprung the beginning of the college.

#### THE INDIAN SCHOOL.

The Rev. Eleazer Wheelock, residing in Lebanon, Conn., was led to meditate upon the subject of his means of support, as his people through lack of means failed to provide bountifully. It occurred to him that if they furnished him with but half a living they were entitled to no more than half of his labors, and he consequently resolved to devote a portion of his time to the education of Indian youth. He at once began his work, which was aided by subscriptions from friends in America and England. The number of pupils, beginning with two, soon rose to thirty, and the Indian charity school was formed. In 1761 the General Court of Massachusetts recognized his efforts, and voted that he should be allowed to take under his charge six pupils from the six nations for education, boarding, and clothing, for which he was to receive twelve pounds per annum for each child, to be paid from the public treasury. In the following year the Legislature of New Hampshire granted fifty pounds sterling per annum for five years as aid to the school. However, this was not paid after the first, or possibly after the second year.<sup>1</sup>

But a growing school and an empty treasury caused Mr. Wheelock to send two agents to England to solicit funds. Accordingly Rev. Mr. Whitaker and Mr. Samson Occum, an Indian preacher, were sent for that purpose in 1765.

A live Indian preacher of a good degree of intelligence, speaking in England, stirred the hearts of the people, and a large sum of money was consequently raised by the agents for the Indian schools, the King being among the chief contributors.<sup>2</sup>

The favorable results of this mission abroad caused Mr. Wheelock to entertain designs for a college. He succeeded in obtaining a charter, granted in 1769. The problem of determining a site for the new school next occupied his attention. Liberal inducements were held out by Connecticut, Pennsylvania, and New Hampshire. It was finally decided after due deliberation to locate the college at Hanover in New Hampshire, and consequently the Indian school was removed there in 1769. The plan for the education of the Indians was embodied in the charter, and the Indian charity school was the basis of the institution chartered. The "laudable design of spreading Christian knowledge among the savages of the American wilderness," and that "the best means of education be established in our province of New Hampshire."

<sup>1</sup> See ch. 172.

<sup>2</sup> Dwight. *Travels in New England*, II, 100. See also Sparks' *Life of John Led* ch. I.

<sup>3</sup> From a copy of the charter; Smith, 459.

were given as the reasons for granting the charter of Dartmouth College.

The original design of educating Indians and missionaries to the Indians was frustrated.<sup>1</sup> For three years after the founding only a small number of missionaries and persons destined as candidates for this employment were sent among the Indians; afterwards all efforts ceased in this behalf.

The inhabitants of Hanover presented the college with twelve hundred acres of valuable land; the State of New Hampshire endowed it with about seventy-eight thousand acres more,<sup>2</sup> in several successive grants, the most important of which was made in January, 1789, when the Legislature gave a tract of four thousand two hundred acres located above Stewartstown.<sup>3</sup> By the terms of this grant the Governor and Council of the State for the time being were incorporated with the trustees for the purpose of acting with them in the management of all funds granted to the college by the State.<sup>4</sup>

Other grants of a moderate amount were made by the State.

The annual revenue of Dartmouth was, in 1793, from tuition about two thousand dollars; from rent of lands about five hundred dollars. It was expected by contracts made in the same year that the income from rents would be one thousand five hundred dollars in 1797, and two thousand one hundred and sixty-six dollars in 1803.<sup>5</sup>

One of the most remarkable grants on record is that made by the Legislature of Vermont in 1785-86. Mr. Wheelock appeared before that body at this time and presented the case of the college; as a result of his pleading the Legislature granted to the college the entire township of Wheelock—one-half for the school and one-half for the college.<sup>6</sup> It was this grant which led Daniel Webster to remark that "The State of Vermont is a principal donor to Dartmouth College."<sup>7</sup>

In 1807, Dr. Wheelock appeared before the General Court and appealed for aid, representing to the Legislature the conditions and needs of the college. As a result of his visit the trustees of the college were granted a township of land six miles square lying on the border of the district of Maine.<sup>7</sup>

#### THE COLLEGE OF AGRICULTURE AND THE MECHANIC ARTS.

The proceeds arising from the sale of the land scrip (one hundred and fifty thousand acres) assigned to New Hampshire were appropriated to the founding of the New Hampshire College of Agriculture and the Mechanic Arts, in connection with Dartmouth College at Hanover.

The act making this appropriation was approved July 7, 1866, and before the close of the following year the scrip was sold at an average

<sup>1</sup> Dwight, II, 103.

<sup>4</sup> Dwight, II, 103.

<sup>6</sup> Webster's Works, V, 472.

<sup>2</sup> *Ibid.*, 101.

<sup>5</sup> *Ibid.*, 102.

<sup>7</sup> Smith, 23.

<sup>3</sup> Smith, 20.

hundreds of thousands of dollars, and on the part of the State by the contribution of eight thousand dollars not obtained from the pockets of the tax-payers, but eight thousand dollars of other people's money."

On the other hand, the State appropriated in 1886 the sum of thirty-five hundred dollars annually for an experiment station under the care of the university; in 1888 the sum of six thousand dollars per annum for chemistry for the next four years, two thousand four hundred dollars for tuition, and three thousand six hundred dollars for instruction in branches relating to the industrial arts.<sup>1</sup>

The following statement, together with what has already been given, will give a fair estimate of the financial condition of the university, exclusive of the Congressional grant:

#### SUMMARY.

|                                                             |           |
|-------------------------------------------------------------|-----------|
| Total value of property, exclusive of contingent fund ..... | \$520,000 |
| Value of lands .....                                        | 130,000   |
| Value of buildings.....                                     | 200,000   |
| Value of collections.....                                   | 60,000    |
| Value of trust fund.....                                    | 120,000   |

The appropriations to Vermont University and State Agricultural College are as follows:

|                                                                                    |          |
|------------------------------------------------------------------------------------|----------|
| Grant of "town lots," 20,000 acres; annual rental is \$2,500; estimated value..... | \$50,000 |
| Annual appropriation for experiment station, \$1,500; 1886-89 .....                | 10,500   |
| Annual appropriation for chemistry, \$6,000; 1888-91, inclusive .....              | 24,000   |
| For tuition, State students .....                                                  | 2,400    |
| For instruction .....                                                              | 3,600    |
| Total .....                                                                        | 90,500   |

<sup>1</sup> Pres. M. H. Bartlett's letter of December 20, 1888.

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to a tuition ranging from three to six guilders per quarter for each pupil. The school must be kept open nine months in the year.<sup>1</sup>

The General Assembly of the province took a more decided stand in 1702, and passed an act providing for a "free school in the city of New York," to be supported by an annual tax of fifty pounds current money.

Thus gradually the schools developed from elementary to grammar grades, and by degrees the legislative authorities took more important steps toward the support of schools. But it was not until 1746 that the first movement was made toward the founding of a college. The first step was to organize a lottery to raise money to found a college. This was repeated several times, and the process of raising money by lotteries for school purposes became a settled policy of the province. In fact, in this period it was considered a legitimate method of raising funds, and was practiced, more or less, by nearly all of the colonies.

It was not until the year 1754, one hundred and eighteen years after the founding of Harvard, that King's College was chartered. This marks the real beginning of higher education in New York. After the close of the Revolutionary War, King's College was reorganized under the name of Columbia College. The policy of the province and State toward higher education was exceedingly encouraging and liberal. All of the early colleges received valuable assistance by means of legislative endowments, grants, or appropriations.

The remarkable feature of the system of education in the Empire State is the Board of Regents of the University of the State of New York. It represents centralized authority for the control of public education, particularly that usually called "higher." In this capacity it has power to grant charters and regulate the laws pertaining to the same, though its work is seconded by legislative enactment. Through its instrumentality a property qualification has been instituted for the admission of colleges to chartered rights. This appears to be a wise measure, and would naturally have a tendency to prevent the establishment of institutions without financial support. If this policy had been pursued by other States fewer institutions would have been brought into existence merely to perish. The measure was not intended to check new non-State institutions. Indeed the State has ever been liberally disposed toward these institutions.

The University Convocation, called annually by the Regents of the University of the State of New York, brings together the chief educators of the State to discuss the most recent problems of education. This has a tendency to unify educational interests and create harmony in the entire system, besides keeping before the public the advanced views of the foremost men in the educational world.

The educational policy of the Swedes on the Delaware was similar to that pursued by the Dutch in New York. After the English domination the policy of Penn was decidedly in favor of founding sufficient

<sup>1</sup> Pratt's Annals, 6.

**schools for the education of the people. The idea of State support developed very slowly. In Delaware the General Assembly has always encouraged all schools, and has lent a continuous support to higher education.**

**New Jersey has adopted an entirely independent policy in regard to higher education. Princeton College takes great pride in the fact that the State never gave any assistance to that institution.**

**In Pennsylvania the early schools were carried on chiefly by the Friends, the Legislature providing for the tuition of a class of indigent children. The school instituted by Benjamin Franklin was the natural successor of the school of Penn, and later developed into the University of Pennsylvania. This institution received a new impulse in Revolutionary times under the provisions of the Constitution of 1776, which resulted in a liberal State endowment.**

**A remarkable feature of education in Pennsylvania appears after the war, in the numerous grants and endowments made to private and sectarian institutions. Academies, seminaries, and colleges sprang up rapidly through State encouragement and assistance. This process finally developed into a system whereby the State could easily provide teachers for primary and secondary schools by the support of colleges and academies. The system finally broke down with its own weight, and there has arisen in its place a complete normal system for the preparation of teachers. State aid for higher education, with the exception of appropriations to the State College and a recent donation for a hospital in Pennsylvania University, has entirely ceased.**

#### NEW YORK.

#### THE DUTCH COLONY.

**In the early history of the colony of New Netherlands there are frequent references to the schools which were established for the benefit of the colonists. Nearly all of these schools were of an elementary character, and were chiefly taught by teachers sent out from Holland in the employ of the Dutch West India Company. In 1659, at the earnest request of the "burgomasters" and "schepens" of New Amsterdam, Alexander Curtius was sent out to form a school of higher grade, in which instruction could be given<sup>1</sup> "in the most useful languages, the chief of which is the Latin tongue."<sup>2</sup> It was desired that this Latin school should finally develop into an academy. This, the only school of higher grade recorded in the Dutch period, closed when the English took possession of New Amsterdam.**

<sup>1</sup> Historical Records, 26.

<sup>2</sup> An earlier document has been found in reference to this same school, being a communication from the directors of the West India Company to the director-general—Pratt's Annals, 21.



## ENGLISH COLONY.

Under the English government that followed there were numerous attempts to establish and maintain Latin schools. The first was opened in 1688 by the Jesuit Fathers, under the direction of Governor Dongan.<sup>1</sup> In 1702, when Viscount Cornbury was Governor, an act was passed which provided for a Latin free school, and appropriated fifty pounds sterling, annually for seven years, for its support. Under this act George Muirson was licensed, in 1704, to instruct "in the English, Latin, and Greek tongues or languages, and also in the arts of writing and arithmetic."<sup>2</sup>

The most important school of this kind was established by Mr. Malcolm in 1732, to teach Greek, Latin, and mathematics. This school was established by an act of the General Assembly, which provided for its support by appropriation of all the revenues arising from licensing peddlers and hawkers about the city of New York. The assembly also voted 40 pounds per annum for five years, to be raised by taxation, for the support of the school.

After the expiration of this time, and during the unsettled period of the French and Indian wars, there is very little in the annals of the English colony to indicate any public aid to education. It is not supposable that the schools thus started were suddenly given up; but they were probably carried on by private parties, and therefore did not enter into the history of colonial affairs.

## KING'S COLLEGE.

As early as the year 1702, we find references to the founding of a university on the "King's Farm" in New York City. The subject was broached again in 1729,<sup>3</sup> but no action was taken until December 6, 1746, when the General Assembly of the colony passed an act for raising the sum of £2,250 by a public lot tery, for the encouragement of learning and for the founding of a college.<sup>4</sup> Other acts followed, and at the close of 1751 the funds, amounting to £3,433 18s, were vested in a board of trustees. Of these trustees two belonged to the Dutch Reformed Church, one to the Presbyterian, and the remaining seven to the Church of England.

The King granted a charter, donated land, and appropriated money for the founding of the college. The charter was granted in 1754, under the title of King's College. The General Assembly, by a subsequent act, provided for its support by granting an excise tax on liquors. A large amount of land had been given to Trinity Church by the King's grant for its support, and on the 13th of May, 1755, the corporation of

<sup>1</sup> David Murray, in Historical Records, 26.

<sup>2</sup> Annals of Education, 87.

<sup>3</sup> Historical Sketch of Columbia College, 6.

<sup>4</sup> F. B. Hough, Hist. Rec., 39.

Trinity Church conveyed a large and valuable tract of this grant, lying on the west side of Broadway between Barclay and Murray Streets, to the governors of the college.

The college was duly organized in 1754, the trustees in the year previous having called Rev. Samuel Johnson to be its first president. The government of the college was vested, by authority of the charter, in the president of the college; the Archbishop of Canterbury; the first lord commissioner for trade and plantations; the eldest councilor of the provinces; the judges of the Supreme Court of Judicature; the secretary; the Attorney-General; the Treasurer; the Speaker of the General Assembly; the mayor of New York City; the rector of Trinity Church; the senior minister of the Protestant Dutch Reformed Church; the ministers of the Lutheran, French, and Presbyterian Churches; and twenty-four citizens of New York City,—a body sufficiently varied in character to control the college and at the same time represent all the interests of the people.

The funds for the support of the new college were raised in several ways: By State assistance, by private donations, by lotteries, and by tuition.

Provisions were early made by the General Assembly for a lottery to raise funds for the erection of buildings, a site having been chosen near Barclay Street, west of Broadway.

It was not, however, until May, 1760, that the buildings were erected, and the remainder of the property was subsequently leased for a term of years. The sum of £3,282 was realized from the lottery; six thousand pounds were obtained by the agent, Dr. Jay, in England; the King gave four hundred pounds; and over ten thousand pounds were contributed by others. In 1767 a grant of twenty-nine thousand acres of land was made by the Government, but this was unfortunately located in that part of the territory afterward ceded to Vermont and was lost to the college.

The college was supported by private donations, aided by the colony, and its control was more or less subjected to the colony; yet it could not be claimed as a State institution, as the term is used in its modern sense.

King's College was closed in 1776 on account of the turbulent times, and was prepared for the use of the American army as a hospital.<sup>1</sup>

During its career it had given an impulse to education which enabled the work to be readily revived at the close of the war. In its early years the Government had granted to it the sum of £6,943, equal to \$17,358, in current exchange, raised by lotteries and taxes, and lands valued at \$83,647, making in all over one hundred thousand dollars, a liberal sum in those days, for the establishment of the new college.

## COLUMBIA COLLEGE.

After the close of the Revolutionary War, King's College was in a deplorable condition. Many of the board of governors were either dead or missing, the libraries were scattered, the apparatus was destroyed, and a complete disorganization existed. The entire income of the college in 1784 was but one thousand two hundred pounds.<sup>1</sup> With this income the board of regents began to build the university.

In 1784 the governors of the college addressed a petition to the State Legislature, then in session, asking a revision of the charter of King's College.<sup>2</sup> At the beginning of this session of the Legislature Governor George Clinton made the following reference to the higher education, which was the beginning of the organization of New York's present magnificent school system: "Neglect of education of youth is one of the evils consequent on war. Perhaps there is scarce anything more worthy your attention than the revival and encouragement of seminaries of learning."<sup>3</sup>

Earlier in the session, and before the petition of the governors of King's College had been presented, a bill was introduced and became a law on the first day of May, 1784. This was entitled, "An act granting certain privileges to the college heretofore called King's College, for altering the name and charter thereof, and erecting an university within this State."<sup>4</sup>

The principal provisions of this act are, in brief, as follows: A board of regents was created, vested with power to hold and possess the rights, privileges, and franchises provided by the act, and were to have power to make rules for the government and support of the university, to elect a president and professors of King's College. The regents could possess estates, real and personal, equal to forty thousand bushels of wheat, and they were empowered to found schools and colleges in the State where they deemed it advisable, and to endow the same.

The board of regents consisted of the Governor, Lieutenant-Governor, mayor of the City of New York, mayor of Albany, Speaker of the Assembly, President of the Senate, Attorney-General, Secretary of State, and twenty-four other persons elected by the Legislature. In addition to this number each religious denomination had the right to elect one regent. This shows the early attempt to unite the church and state in educational matters.

The property of King's College was given into their charge, to be applied solely to the use of Columbia College as the regents might direct. The regents were likewise empowered to grant degrees, and finally in Section X, we read: "The college heretofore known as King's College shall be known and called Columbia College."

Thus we find a full organization with one college and a small income as the beginning of the University of the State of New York. During

<sup>1</sup> Moore's History of Columbia College, 64.

<sup>2</sup> Hist. Rec., 40.

<sup>3</sup> *Ibid.*, 41.

<sup>4</sup> Laws of 1784, Chap. LI, p. 68.

the second session of the Legislature of 1784, the above act was, owing to dissatisfaction, amended in some particulars. These amendments pertained chiefly to administration, but among other things they provided for an increase in the number of regents.

The arrangement provided by this legislation lasted for three years only; at the end of this period of trial it was felt that there was need of a reform. A committee was appointed to consider the measure in relation to the university, and especially to Columbia College. Mr. Duane, as chairman of the committee, reported that the previous acts of the Legislature were considered defective, and recommended changes in regard to the functions of the regents and also in the action toward academies.

The report was adopted, and a subsequent committee presented a bill for the action of the Legislature. The act repealed all former acts and made the number of regents twenty-one, including the Governor and Lieutenant-Governor as members in virtue of their offices.<sup>1</sup> The other regents were appointed by the Legislature, and the board of regents chose their own officers, viz, chancellor, vice-chancellor, secretary, and treasurer.<sup>2</sup>

The law states as follows: "The regents are authorized and required by themselves or their committees to visit and inspect all the colleges and academies in the State, examine into the condition and system of education and discipline therein and make an annual report of the same to the Legislature."<sup>3</sup> They also have full control of the literature fund, which is annually distributed and appropriated to the different academies and seminaries of learning, exclusive of colleges, according to the number of students passing satisfactory examinations in the classics and higher branches of learning.<sup>4</sup>

The regents of the university and the trustees of Columbia College were made two separate bodies. The charter granted in 1754 was ratified, and the number of trustees in control was limited to twenty-four, in whom were vested all the powers of the governors of the college. Ample provision was made in this bill for the establishment and government of academies. Since this act the board of regents has been divested of the charge of Columbia College and has had no control of its internal affairs.

From the time of reorganization in 1787 the regents of the University of New York have exercised a supervisory control over the corporations created by them or by the Legislature, while Columbia College, although nominally under the supervision of the regents, has had, as in case of the other great institutions of learning in the State, an almost independent existence.

<sup>1</sup> Laws of 1787, 10th session, p. 156.

<sup>2</sup> New York Code, 1822, Chap. XV, p. 1114.

<sup>3</sup> *Ibid.*, sec. 15, p. 1115.

<sup>4</sup> *Ibid.*, sec. 23, p. 1116.

The Legislature continued to assist Columbia College in small ways for some years after the separation. In 1792 an act to encourage literature provided for the payment of £7,900 to the college for certain specified objects, and at the same time granted an annuity of seven hundred and fifty pounds for a term of five years.<sup>1</sup>

Columbia College shared with Union College in a land grant from the State in 1801, located at Lake George, Ticonderoga, and Crown Point. A more valuable grant followed in 1814, that of twenty acres of land formerly belonging to Dr. Hosack and purchased from him by the State at a cost of \$74,268.75.

Dr. Hosack attempted to establish a botanical garden subservient to the purposes of medicine, agriculture, and the arts. He purchased the land and erected buildings, but was unable to carry out his plans. The land when purchased was three miles and a half outside the city of New York, but is now in the center of wealth and population and is very valuable. It is located between Fifth and Sixth Avenues, and between Forty-seventh and Fifty first Streets.

One other act of 1819 granted to Columbia College the sum of ten thousand dollars.

A medical school was early established in connection with Columbia College, which received assistance from the Colonial Assembly and the State Legislature. The corporation of the city of New York granted three thousand pounds, while the State Legislature assisted to the extent of forty-five thousand dollars by means of lotteries, chiefly after this school was united with the College of Physicians and Surgeons.

#### THE LITERATURE FUND.

One of the substantial aids to the success of the school system of New York is what is termed the Literature Fund.

By an act of May 10, 1784, the board of commissioners of the land office was created and empowered to lay out the unappropriated land into townships ten miles square. In each township a lot of three hundred acres was reserved for the use of a minister of the Gospel, and six hundred and ninety acres for a school or schools.

By an act of May 5, 1786, entitled "An act for the speedy sale of unappropriated lands within this State, and for other purposes therein mentioned," the surveyor-general was authorized "to lay out the waste and unappropriated lands" of the State into townships ten miles square, and these townships into lots of six hundred and forty acres each.<sup>2</sup> The act further provided "That in every township so laid out, or to be laid out as aforesaid, the surveyor-general shall mark one lot on the map 'Gospel and Schools,' and one other lot for 'Promoting Literature,' which lots shall be as nearly central in every township as may be; and the lots so marked shall not be sold, but the lot marked 'Gos-

<sup>1</sup>Greenleaf, II, 479.

<sup>2</sup>Hist. Rec., 80.

pel and Schools " shall be reserved for and applied to the promoting the Gospel and a public school or schools in such townships; and the lot marked for "Promoting Literature," shall be reserved to the people of this State to be hereafter applied by the Legislature for promoting literature in this State."<sup>1</sup>

Of these two provisions the former furnished the basis of local school funds, the latter of the literature fund, which is still held by the State.

But the lands reserved for the support of schools were for many years unproductive, and the board of regents was without funds for successful compliance with the law in performing its duties. In the report of 1788 the board of regents lamented this condition of affairs and their inability to make an improvement, unless the Legislature would support them by appropriate acts. They claim: "As the education of youth and culture of learning are connected with the improvement of useful arts, and nourish both the disposition and abilities requisite for the defence of freedom and rational government, so they have been esteemed in every civilized country as the objects of the highest importance. In our State it was evidently intended that the university should possess and exercise a general superintendence over all literary establishments which might be found among us, and that it should direct the system in such a manner as would conduce to the harmony and interest of the whole. \* \* \* Our attention would naturally extend, not only to subsisting literary corporations, but to the erection of academies in every part of the State; and it is obvious that the most important purposes might be attained by affording timely assistance to infant seminaries, which would otherwise languish for a time and perhaps finally perish."<sup>2</sup> Therefore, as the university is not provided with funds for the payment of the expenses immediately arising from the duties which the legislature has prescribed, the regents suggest that certain lands be made available for its support.

#### LAND GRANTS.

A plea for necessary assistance was again urged by the regents in the following year. As the result of their petition the Legislature passed an act on March 31, 1790, entitled "An act for the further encouragement of literature," which, after stating that it is the duty of a free people to promote and patronize science and literature, and that Columbia College and the incorporated academies under the charge of the regents are deficient in funds, notwithstanding the contributions of individuals, provided for the rental and lease of lands and the application of a sum of money without delay for the "advancement of science and literature in the said colleges and the respective academies."

It was further provided that certain lands of Crown Point, Ticon-

<sup>1</sup> Chap. 67, Laws of 1786; Greenleaf, I, 282.

<sup>2</sup> Regents' Report, 1788.

<sup>3</sup> Chap. 38, Laws of 1790; Greenleaf, II, 316.

deroga, Fort George, and Governor's Island<sup>1</sup> should be given to the regents for the support of literature.<sup>2</sup> The grant at the south end of Lake George having been found to conflict with prior grants, the Legislature substituted in lieu thereof a tract on the east side of the lake, containing 1,724 acres.

An act of the Legislature of May 5, 1786, granted ten townships at the northern part of the lake for general educational purposes, but these were afterward replaced by a grant of 1,680,000 acres in the counties of Cayuga, Onondaga, Oswego, Schuyler, Seneca, Tompkins, and Wayne. This grant is known as the reservation for educational purposes in the "military tract." Six lots in each township were reserved as follows: one for promoting the Gospel and a public school; one for promoting literature in the State; and the other four to equalize the shares of claimants under the bounty act. In 1769 the supervisors of Onondaga County, which then included the whole of this tract, were authorized to set apart the lots to be devoted to literature. These and other reservations were granted to separate institutions or sold to increase the general literature fund.<sup>3</sup> Thus, for example, the literature lots in townships 7, 8, 9, 10, 11, 12, 15, 16, 17, and 20 were granted to Union College, while others, from time to time, were granted by special acts of the Legislature to various academies. Eight townships in St. Lawrence County were sold and the proceeds were given to the literature fund, with the exception of \$1,000 to Middlebury Academy in 1823, \$1,000 to Redhook Academy in 1824, and \$2,500 to St. Lawrence Academy in 1825. These latter grants were made by special acts of the Legislature.<sup>4</sup>

Much had been done for the support of academies by general and special grants of land, and the Legislature had attempted to supply the deficiency of these grants by special money appropriations. The greatest of the latter was the act of 1792, which granted an annuity of \$1,500 for five years for the benefit of academies.<sup>5</sup> But the origin of a permanent Literature Fund, the interest of which was to be used for the support of academies and the principle to remain undiminished, dates from the act of the Legislature of 1813, which provided that certain unsold lands in the military tract, or the counties of Broome and Chenango, should be sold and the proceeds invested to secure a regularly-paid interest. "And the regents of the university shall make such distribution of the annual income amongst the several incorporated academies of this State as in their judgment shall be just and equitable."<sup>6</sup>

By an act passed April 12, 1813, the Crumhorn Mountain Tract was authorized to be sold and the proceeds were to be used for the benefit of academies, as the regents might direct. The avails of this sale, amounting to \$10,416, went into the Literature Fund.

<sup>1</sup> Afterward used for military purposes.

<sup>2</sup> Laws of New York, Greenleaf, II, 317.

<sup>3</sup> Hist. Rec., 84.

<sup>4</sup> Statutes, 45, 330, 62.

<sup>5</sup> Greenleaf, II, 479.

<sup>6</sup> Statutes, p. 319. 1813.

The Literature Fund was further increased by an act of 1819<sup>1</sup> authorizing the arrears of quit-rents, amounting to \$53,380, to be equally divided between the Literature and the Common School Funds. And in 1827, April 13,<sup>2</sup> the avails of the lands belonging to the Canal Fund to the amount of \$150,000 were to be devoted to the enlargement of the Literature Fund, and to be distributed for the support of incorporated academies and seminaries, excluding colleges, which were subject to the visitation of the regents.

LOTTERIES FOR THE LITERATURE FUND.

At the present day it seems a questionable way to support colleges and schools by means of lotteries. But at the beginning of this century there seems to have existed a mania for lotteries, and they were considered a legitimate method of raising money. Many colleges and academies and even churches availed themselves of lotteries to replenish their funds. Nearly all of the young States indulged in this method, and New York especially was much given to this mild gambling for public gain.

By an act of the Legislature, passed April 3, 1801, entitled "An act for the promotion of literature,"<sup>3</sup> provision was made for four successive lotteries of twenty-five thousand dollars each; \$12,500 of the avails of each was to be paid to the Literature Fund, and this was to be distributed among the academies by the regents; the remainder was to be devoted to the support of the common schools.<sup>4</sup>

By an act of 1832 the management of the Literature Fund was directed to be transferred from the control of the regents to the State Comptroller, who was to audit all accounts for the support of academies and for current expenses.<sup>5</sup> At this time the Literature Fund was largely invested in bank stock, State stock, bonds, and mortgages, amounting in all to only \$59,407.51, with property held in trust by the regents amounting to \$9,905.07. This fund amounted September 30, 1888, to \$284,201.30. Its revenue is applied entirely to the support of academies.

The United States Deposit Fund of 1836 was entirely devoted to education. The principal of this fund amounted to \$4,014,520.71, and from its income, \$28,000 are given annually to the support of academies. Thus has the Literature Fund continually increased, and its entire proceeds have been directed to the support of academies. But this fund failing to meet the requirements, an appropriation<sup>6</sup> of \$125,000 was made by Legislature, the money to be divided as the present Literature Fund. A tax of one-sixteenth of a mill was levied on each dollar of valuation.<sup>7</sup> It was provided in the act of distribution of the funds in 1873<sup>8</sup> that no more money should be paid to a school under the control

<sup>1</sup> Chap. 222, Laws of 1819, p. 297.

<sup>2</sup> Chap. 225, Laws of 1827, p. 237.

<sup>3</sup> Chap. 53, Laws of 1801.

<sup>4</sup> Chap. 7, Laws of 1802.

<sup>5</sup> Chap. 571, Laws of 1872.

<sup>6</sup> Chap. 736, Laws of 1872.

<sup>7</sup> Chap. 642, Laws of 1873.



of any religious or denominational sect or society. This State aid to academies, which was appropriated in 1872, was not continued by subsequent Legislatures. But in 1887<sup>1</sup> the Legislature enacted that sixty thousand dollars should each year be appropriated, to be distributed by the regents of the university in the same way as the income of the Literature Fund is distributed.

#### UNION COLLEGE.

The first movement toward the foundation of Union College was made in 1779, by the circulation of a petition for a bill to charter Olin-ton College at Schenectady. This plan failing, measures were taken in 1785 to found an academy in the town of Schenectady. The enterprise was supported entirely by private munificence. On December 30, 1791, the Legislature was memorialized without success for a grant of land for the support of the new institution. In February, 1792, the proprietors of the academy petitioned the Legislature for a charter, which was denied on account of lack of sufficient funds. In the following year the petition was renewed in a different form, asking for an academic charter, which was granted January 26, 1793.

After repeated attempts a charter for Union College was obtained February 25, 1795, from the regents of the university, to whom authority had been given by the Legislature. The property of the Schenectady Academy was made over to its support. The Legislature came to the assistance of the new and struggling institution, and made the following grants: By an act of April 9, 1795, the sum of \$3,750 was granted for books; April 11, 1796, ten thousand dollars for building purposes; March 30, 1797, \$1,500 for salaries; and on March 7, 1800, ten thousand dollars for building and permanent funds. By the last act the trustees were granted the power to select ten lots in the military tract, to be sold, and the proceeds to be devoted to the use of the college. The sale of these lands, together with others near Lake George, yielded over fifty thousand dollars. Previous to 1804 the whole amount given by the State in support of the college was \$78,112.13,<sup>2</sup> and this was either as appropriations of money or funds from the sale of lands.

In 1804 began the celebrated administration of Dr. Nott, continuing for over a half century. Dr. Nott, although a Christian minister, according to the fashion of his times began to provide for an ample endowment by the aid of lotteries. On March 30, 1805, an act of the Legislature granted the privilege of a lottery of eighty thousand dollars in four drawings; and on April 13, 1813, an act authorized a lottery of two hundred thousand dollars, designating the proceeds for several purposes. Thus was Union College aided in time of need by the generosity of the State, although, like most of the old colleges, it was largely sup-

<sup>1</sup> Chap. 622, Laws of 1887.

<sup>2</sup> Chap. 120, Laws of 1814.

<sup>3</sup> Chap. 62, Laws of 1805.

ported by private donations. The entire State aid given to Union College amounted to \$358,111.

#### HAMILTON COLLEGE.

The third college in New York, that of Hamilton, located at Clinton, received material assistance from the State. It had its origin in an academy chartered under the name of Hamilton-Oneida, on January 31, 1793, at the village of Clinton. The academy was opened in 1799 for the admission of students. After a successful period of growth for a term of 12 years it was transformed into a college, under a charter granted by the Regents, May 26, 1812. By an act<sup>1</sup> of the Legislature of June 19, of the same year, the college was endowed with the sum of fifty thousand dollars in bonds, secured on the unsold lands of the Oneida Reservation. The general lottery act of 1814 gave to Hamilton College the sum of forty thousand dollars. In 1836 the State made an annual appropriation of three thousand dollars, which ceased under the provisions of the new Constitution of 1846. The total State aid amounted to only one hundred and twenty thousand dollars, but the permanent funds of the college in 1881 amounted to \$269,332.56.

The University of the City of New York received a grant of six thousand dollars per annum from 1838 to 1843, and other institutions have received special appropriations; but the history of these institutions must be omitted here. A general summary of the grants will be given at the close of this part of the subject.

#### CORNELL UNIVERSITY.

The nearest approach to a State institution of superior instruction found in New York is furnished by Cornell University. The Governor, Lieutenant-Governor, Speaker of the Assembly, and Superintendent of Public Instruction are in virtue of their respective offices members of the board of trustees. Hon. Ezra Cornell agreed to give five hundred thousand dollars, for the foundation of the university, provided that the proceeds of the Agricultural Land Grant should remain undivided, and be devoted to said university for the purpose of instruction in the mechanical arts and agriculture.

New York State received 990,000 acres in land scrip from the United States grant of 1862, part of which was sold for eighty-five cents per acre. Land scrip went down, and by an act of the Legislature of April 10, 1866, the Comptroller was authorized to sell the land to the trustees of Cornell University, or to any person giving good security, for not less than thirty cents per acre. Mr. Cornell bought the remaining portion, and agreed to pay into the State treasury the net proceeds of these lands, the sum to be held as the Cornell Endowment Fund, and to be used exclusively for the support of the university.<sup>2</sup> The profits of this investment will amount at least to two millions of dollars.

<sup>1</sup>Chap. 237, Laws of 1-12.

<sup>2</sup>Chap. 4-1, Laws of 1866.

By the laws of 1865,<sup>1</sup> which were amended in 1872,<sup>2</sup> and again in 1887,<sup>3</sup> Cornell University is obliged to receive from each Assembly district one student annually, to whom is given free instruction in all branches in the four-years' course. This act gives free tuition continually to five hundred and twelve students. The privilege is determined on a basis of superior scholarship, and is determined by competitive examinations conducted by the Department of Public Instruction.

The State has done very little for the support of Cornell University; the chief benefactors are Ezra Cornell and the Federal Government. Stimulated by these magnificent gifts, private donations have poured in for the support of this great institution, which in purpose and design is a complete State University.

#### THE STATE MUSEUM OF NATURAL HISTORY.

The regents of the University of New York were created by an act of the Legislature in 1845, trustees of the Cabinet of Natural History. By an act passed in 1870 the name was formally changed to the New York State Museum of Natural History. The board has the power to appoint the scientific staff, consisting of a director and his assistants, a State entomologist, and a State botanist. The Museum is a means of increasing scientific knowledge in the State. It received its first impulse through the State Geological Survey, and the attempt which grew out of this survey to form a collection of the natural productions of New York. By an act of the Legislature of November, 1840, the old State Hall at Albany was set apart for the reception of the collections.<sup>4</sup> They were put in charge of the regents. The Legislature also appropriated two thousand dollars for fitting up the building and the cases. In 1857 a new building replaced the old one, to meet the demands of the growing collection.

A new interest was awakened in the Museum by the discovery of the mastodon at Cohoes in 1866, and the Legislature in the next session granted five thousand dollars for the purchase of the Gould collection of shells, of sixty thousand specimens, representing six thousand species.

In 1870 a law was passed making an annual appropriation of ten thousand dollars for the support of the director and three assistants, as well as for current expenses. Also the sum of one thousand five hundred dollars was appropriated for the salary of the State botanist. By an act passed in 1881 the sum of two thousand dollars was appropriated for the annual salary of a State entomologist.

The Legislature by an act of 1883 directed that the State Hall, as rapidly as it was vacated by the State officers, should be set apart for the use of the Museum, and in the same act increased the annual ap-

<sup>1</sup> Chap. 585, Laws of 1865.

<sup>2</sup> Chap. 634, Laws of 1872.

<sup>3</sup> Chap. 291, Laws of 1887.

<sup>4</sup> Chap. 245, Laws of 1840, 192.

proprietion to fifteen thousand dollars. It also provided for the publication of scientific papers, and the remaining unpublished volumes of the Natural History of the State, directing funds to be appropriated annually for five years to these purposes. The removal of the Museum to the State Hall has only been partly effected. The delay in the completion of the new capitol has interfered with the removal of the State officers, and the additions to the number of officers and boards begin to make it doubtful if the State Hall can ever be vacated.

An institution like the State Museum furnishes a strong support for higher scientific education.

## ACADEMIES.

The academies of New York, although now properly classified as institutions of secondary instruction, have borne such intimate relations to higher education in the past that they should not be passed by unnoticed. Here, as elsewhere, we are confronted with the indefinite terms of "academies" and "seminaries of learning," embracing, as they do, historically all grades of instruction from that of an ordinary grammar school to that of a moderate collegiate course. But as the appropriations have largely been made on the returns of classical education the system of academic education is entitled to our attention to that extent.

After the reorganization of the school laws, at the close of the Revolutionary War, the newly constituted board of regents, in 1787, provided for the establishment of two academies, those of Clinton at East Hampton and Erasmus Hall at Flatbush. These were reported in 1788 as being in a flourishing condition. Subsequently others were added to the list of newly incorporated academies, until in 1792 there were ten of these academies. They had received but meagre support from their land endowments, and it was not until 1792 that the first direct appropriation<sup>1</sup> of moneys was made by the Legislature for the support of academies, and a provision made for its distribution among the academies of the State by the board of regents.

The act of April 11, 1792, that provided for a donation to Columbia College, also appropriated the sum of one thousand five hundred pounds (\$3,750) annually for a term of five years, to be distributed at the discretion of the regents among the several academies of the State.<sup>2</sup>

These funds were appropriated at first according to the number of pupils in attendance at the respective schools. Finally in 1818 a rule was adopted distributing the funds according to the number of students studying the classics or the higher branches of learning, reserving one-fifth of the entire amount for special distribution to over-needy institutions according as the regents might deem proper. This policy was pursued until the revised statutes of 1829 provided that the money should

<sup>1</sup> Hist. Rec., 444.

<sup>2</sup> Chapter 79, Laws of 1792.

be equally divided among the eight senatorial districts of the State, and distributed as before. This remained a law until the adoption of the new Constitution in 1846, which provided for a return to the old method.

There was no well-organized plan for determining the basis of apportionment until 1866, when examinations were instituted, certificates issued, and reports to the regents made accordingly. In 1870 the answer papers of these examinations were made returnable at the office of the regents, and were there subject to review and revision. The law of 1873 provides, among other things, that "no money shall be paid to any school under the control of a religious or denominational sect or society."<sup>1</sup>

The academies, under the protection of wise laws, increased rapidly in number and efficiency. In 1820 there were forty-eight academies to which charters had been granted, although only thirty reported for the apportionment. Besides the regular distribution of funds by the regents, amounting in the aggregate to about two millions of dollars, the Legislature has made at least sixty special grants of land and money for the benefit of academies. It is impossible within the scope of this work to give the specific grants of land or enter into the details of the separate acts of the Legislature. At least fifty thousand dollars have been granted from time to time to academies in need of immediate assistance, while it is difficult to estimate the money value of the numerous special land grants that have been made by the Legislature.

The amount of appropriation varied from year to year until 1830; then it was uniform till 1834, being ten thousand dollars annually. From 1835 to 1838 it was twelve thousand dollars per annum, and from 1839 to 1887 it has been forty thousand dollars per annum. By an act passed in 1887 the sum of sixty thousand dollars was added to the annual appropriation to academies, making the total appropriation from that time at the rate of one hundred thousand dollars annually. Of this amount twelve thousand dollars is taken from the income of the Literature Fund and twenty-eight thousand dollars from the United States Deposit Fund, and sixty thousand dollars from the General Fund.

The State also has appropriated three thousand dollars annually from 1845 to 1883, and six thousand dollars annually since 1884 to be granted by the regents to the academies under their visitation for the purchase of books and apparatus, on the condition that the academies should raise an equal sum from sources independent of their school property. From the excess of applications over the sum appropriated the regents have limited the applications to one hundred and fifty dollars each, and restricted them to alternate years.

The regents also have promoted the maintenance of classes in the academies under their visitation for instruction of common school

<sup>1</sup>Laws of 1873, sec. 7, p. 997.

**teachers.** This system was begun in 1834, and the appropriations sustaining it were derived from the United States Deposit Fund. The sum now appropriated is thirty thousand dollars annually, but the part of this sum actually paid out by the regents depends on the amount of service rendered. The academies are paid one dollar for the instruction of each scholar for each week. The classes are limited to twenty-five members, and continue from ten to thirteen weeks. An inspector is employed, who spends his whole time in visiting and caring for these classes. He is paid from the fund appropriated by the Legislature for the support of these classes.

The total amount of money distributed by the board of regents for academies from 1793 to 1884, inclusive, has been \$1,996,738.18, and to 1888 at least \$2,156,738.18.

#### THE REGENTS OF THE UNIVERSITY OF THE STATE OF NEW YORK.

The act of the Legislature of 1787 created a board of regents, whose specific duties were to care for Columbia College, and to incorporate and supervise such other colleges and academies as they might think proper. However, they were soon at the head of the entire educational department, and were advocating the establishment of a system of common schools, academies, and colleges. It was finally considered that the regents had to supervise only higher education, and to support literary and scientific institutions.

The University of the State of New York is far from being a fiction, although the regents have not chartered all of the educational institutions of the State or entered into the internal supervision of the colleges and academies belonging to the University; nevertheless, by general superintendence and especially by the control of incorporation they have added unity and strength to the schools of the State. Perhaps their greatest service has been in fixing the standard of requirements for incorporating colleges and academies, and bringing academies to a higher grade, by making the appropriations depend either upon the number of pupils, or the number of students pursuing classical studies and the higher branches of learning, and determining the latter by an examination test.

Early in the history of the board of regents, academies and colleges were not granted charters unless a certain amount of property had been secured and there were good indications that the proposed institutions would receive sufficient support.

#### RULES FOR INCORPORATION.

"It was resolved on March 23, 1801, that in future no academy ought to be incorporated unless it appeared to the satisfaction of the regents that a proper building for the purpose had been erected, finished, and

paid for, and that funds had been obtained and well secured, producing an annual net income of one hundred dollars."<sup>1</sup> By a resolution of March 15, 1815, the sum required for investment was raised so as to yield two hundred and fifty dollars per annum. On March 25, 1834, the regents ordered that a building and lot free of any incumbrance and an established school after an approved method be added to the requirements for a charter. By an act of April 17, 1838,<sup>2</sup> it was provided that any academy owning a building, library, and apparatus worth two thousand five hundred dollars, might be subject to the visitation of the regents.

The settled policy of the regents in regard to the incorporation of colleges was published in a report of a committee in 1811, which affirmed "that no college ought to be established until suitable buildings have been provided and a fund created consisting of a capital of at least fifty thousand dollars, yielding an income of three thousand five hundred dollars."<sup>3</sup>

In 1836 the amount of the required endowment was increased to one hundred thousand dollars, with buildings, grounds, etc., worth thirty thousand dollars, the endowment to be made previous to the granting of the charter, and the whole sum of one hundred and thirty thousand dollars secured before the regents would appoint a president. The above restrictions, though seemingly arbitrary, have doubtless raised the character of institutions, while they have suppressed many attempts to found colleges and academies which must have eventually ended in disaster if not thus early thwarted by the law. When we consider the great number of educational institutions that have been called into existence in the United States without proper means of support, that eke out a miserable existence and finally perish for want of proper direction and support, it will be at once seen that the board of regents of New York have rendered a service to the State in these wise provisions.

The legislature by special acts could modify the rulings of the board of regents, as in the case of the granting of the charter to the College of Physicians and Surgeons in New York City with a required endowment of fifty thousand dollars.

The great work of the University of the State of New York has been enlarged until the regents have under visitation (1889) 301 academies.<sup>4</sup> There are also under inspection twenty-seven colleges of arts and sciences for men (or men and women), five colleges of arts for women, eighteen medical colleges, and six law schools, making the immense system subject to State control, although the majority of colleges and universities have been granted such extended powers as to be practically independent in their government.

<sup>1</sup> Hist. Rec., 409.

<sup>2</sup> Hist. Rec., 94.

<sup>3</sup> Statutes of 1834, 296.

<sup>4</sup> 192d Annual Report of the Regents of the University, 1889.

# STATE GRANTS TO COLLEGES AND ACADEMIES.

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## STATE GRANTS TO COLLEGES AND ACADEMIES.

### Columbia College:

|                                                          |                 |
|----------------------------------------------------------|-----------------|
| Grants to King's College by excise and by lotteries..... | \$17,358        |
| Grants of land, including Botanical Garden.....          | 83,647          |
| Grants in money.....                                     | 39,125          |
|                                                          | <hr/> \$140,130 |

### Union College:

|                                         |               |
|-----------------------------------------|---------------|
| Grants by lotteries, 1805 and 1814..... | 280,000       |
| Grants of land, 1800 and 1802.....      | 52,861        |
| Grants in money.....                    | 25,250        |
|                                         | <hr/> 358,111 |

### Hamilton College:

|                                    |               |
|------------------------------------|---------------|
| Grant from sale of land, 1812..... | 50,000        |
| Grant by lottery, 1814.....        | 40,000        |
| Grants in money, 1836-46.....      | 30,000        |
|                                    | <hr/> 120,000 |

**Geneva College:** Grants in money, 1832-46..... 63,000

**University of the City of New York:** Grants in money, 1832-43..... 30,000

**Elmira Female College:** Grants in money, 1867 and 1886..... 37,000

### Fairfield Medical College:

|                                  |              |
|----------------------------------|--------------|
| Grant from land sales, 1812..... | 10,000       |
| Grants in money, 1820-25.....    | 5,000        |
|                                  | <hr/> 15,000 |

**Ingham University:** Grant in money, 1861..... 5,000

**University of Rochester:** Grant in money, 1857..... 25,000

**College of Physicians and Surgeons:** By lotteries..... 45,000

**Albany Medical College**..... 15,000

**Genesee College:** Grants in May, 1854-56..... 12,000

**Cornell University**..... 125,000

**Total appropriations to colleges**..... 890,241

### Academies:

|                                                    |              |
|----------------------------------------------------|--------------|
| Amount to academies by the Regents, 1793-1884..... | 1,996,738.18 |
| Amount by special acts of Legislature, about.....  | 50,000.00    |
| Amount from special grants.....                    |              |

**Total appropriations to academies**..... 2,046,738.18

**Total appropriations to State Museum, over**..... 225,000.00

**The report of 1886<sup>1</sup> shows the following appropriations of the State for higher education:**

|                                                                     |                  |
|---------------------------------------------------------------------|------------------|
| <b>State appropriation for academies</b> .....                      | \$14,244.74      |
| <b>State appropriation for teachers' classes in academies</b> ..... | 31,667.35        |
| <b>Regents of the University</b> .....                              | 14,094.36        |
| <b>Elmira Female College</b> .....                                  | 12,000.00        |
| <b>American Museum of Natural History</b> .....                     | 16,942.96        |
| <b>Total</b> .....                                                  | <hr/> 128,752.41 |

<sup>1</sup> Laws of 1867, Chap. 174.

<sup>2</sup> Report of the Superintendent of Public Instruction for 1886.



## 148 FEDERAL AND STATE AID TO HIGHER EDUCATION.

### *Apportionment to Academies from the Literature and Other Funds.*

|                                                  |             |
|--------------------------------------------------|-------------|
| Total to 1883 taken from Historical Records..... | \$1,996,736 |
| 1884 .....                                       | 40,000      |
| 1885 .....                                       | 40,000      |
| 1886 .....                                       | 40,000      |
| 1887 .....                                       | 40,000      |
| 1888 .....                                       | 100,000     |
| 1889 .....                                       | 100,000     |

Total ..... 2,356,736

### *Grants to Academies to aid them in Purchasing Books and Apparatus.*

|                                             |           |
|---------------------------------------------|-----------|
| Total to 1884, from Historical Records..... | \$158,359 |
| 1885-1889 .....                             | 27,728    |

Total ..... 186,087

Not drawn ..... 750

Total payments by State..... 186,337

### *Expenditures by the State for the Maintenance of Teachers' Classes in the Academies under the Visitation of the Regents.*

|                                             |          |
|---------------------------------------------|----------|
| 1836 to 1841, from Historical Records.....  | \$22,800 |
| 1842-1849 not given.                        |          |
| 1842 to 1877, from Historical Records ..... | 459,847  |
| 1878 to 1889, from Historical Records ..... | 330,000  |

Total (except 1842-1849) ..... \$812,647

### *Summary of Expenditures by the State for Educational Purposes.*

|                                      |           |
|--------------------------------------|-----------|
| Gifts to colleges .....              | \$890,241 |
| Apportionment to academies .....     | 2,356,736 |
| Grants for books and apparatus ..... | 186,337   |
| Teachers' classes.....               | 812,647   |
| State library .....                  | 632,996   |
| State museum (not obtained).         |           |

Total to 1889 ..... 4,876,406

## THE STATE LIBRARY OF NEW YORK.

State libraries have become in many States valuable aids to higher education. Though this branch of the subject has not been exhaustively treated, a short sketch of the State Library at Albany, kindly furnished by Hon. David Murray, of that city, will be sufficient to illustrate what may be done toward advanced learning by this means.

The State Library of New York was established by an act<sup>1</sup> of Legislature passed in 1818. The Governor, Lieutenant-Governor, Chancellor of the Court of Chancery, and the Chief Justice of the

<sup>1</sup> Chap. 45, Laws of 1818.

preme Court were constituted a board of trustees. The Secretary of State, the Attorney-General, and the Comptroller were added to the board of trustees<sup>1</sup> in 1824. By an act<sup>2</sup> passed in 1844 the regents of the university were created the trustees of the library, and since that time it has remained in their charge. It was at first kept in rooms in the old capitol building, but in 1854 it was transferred to a building erected for it at a cost of \$94,900. This building was required to be taken down to make way for the new capitol. The library has been finally, in 1889, removed to its permanent and beautiful quarters on the western front of the capitol.

At first the library was mainly a collection of law books. In 1844, when it was transferred to the care of the regents, it was estimated to contain ten thousand volumes, of which three hundred are reported as missing. The Warden collection, containing two thousand two hundred volumes of miscellaneous works, was purchased in 1846 for four thousand dollars. The two largest collections which have been given to the library are the publications of the commissioner of British patents, amounting now (1889) to more than 4,340 volumes, and the library of the late Hon. Harmanus Bleeker, of Albany, numbering about two thousand volumes. According to the report of the library, September 30, 1888, it contained 138,191 volumes, of which 41,231 volumes belonged to the law department and 96,960 volumes to the department of miscellaneous literature.

We give below the amounts appropriated by the State for the purchase of books and the maintenance of the library from its origin to the present time, arranged in periods of ten years:

| * Expended for the Library. | For the purchase of books and binding. | For maintenance (salaries, expenses, etc.) | Total.         |
|-----------------------------|----------------------------------------|--------------------------------------------|----------------|
| 1818-1828 .....             | \$12,454                               | \$3,627                                    | \$16,081       |
| 1828-1838 .....             | 9,883                                  | 7,439                                      | 17,322         |
| 1838-1848 .....             | 33,940                                 | 18,296                                     | 52,236         |
| 1848-1858 .....             | 41,715                                 | 38,967                                     | 80,682         |
| 1858-1868 .....             | 49,615                                 | 60,891                                     | 110,506        |
| 1868-1878 .....             | 63,744                                 | 85,165                                     | 148,913        |
| 1878-1888 .....             | 73,479                                 | 133,796                                    | 207,275        |
| <b>Totals</b> .....         | <b>284,811</b>                         | <b>348,161</b>                             | <b>632,972</b> |

## PENNSYLVANIA.

## COLONIAL SCHOOLS.

During the occupation of Pennsylvania by the Swedes, and subsequently by the Dutch, until the English occupation, there was but little exercise of the duties of a State, owing to the diffusion of the small number of settlers. Yet from the condition of affairs in the mother

<sup>1</sup> Chap. 252, Laws of 1824.<sup>2</sup> Chap. 255, Laws of 1844.

countries, Sweden and Holland, and from the instructions and privileges contained in the first charters, we may determine the attitude of these colonists toward education, and may infer what would have been the result had they remained in power.

#### EDUCATION AMONG THE SWEDES.

In Sweden the church was a state institution, and the state had intrusted to its care the education of youth, and, through the agency of the church, free schools were established throughout the kingdom. That such a policy was to be continued to the colonists is indicated by the privileges granted to the new colony by the Queen in 1640.

Among other things concerning social improvement it is enjoined that "The patrons of this colony shall be obliged to support at all times as many ministers and school-masters as the number of inhabitants shall seem to require, and to choose, moreover, for this purpose persons who have at heart the conversion of the pagan inhabitants to Christianity."<sup>1</sup>

#### EDUCATION AMONG THE DUTCH.

The Dutch colonists in Pennsylvania, as in New York, were tireless in their efforts to establish schools for their children, yet the means for accomplishing the desired end were meagre, indeed. The duties of minister and school-master were often combined, and churches were frequently used in place of school-houses. In all probability there was not a school-house with a regularly organized school in existence among the Pennsylvania colonists until after the territory passed into the hands of the English. Nevertheless, all available means were used to promote education, and the sentiments were there, awaiting more favorable circumstances for their full expression.

In the Charter of Privileges granted to the "lords and patroons" of New Netherlands in 1630 to 1635, it is provided in section 28 that "the patroons shall also particularly exert themselves to find speedy means to maintain a clergyman and schoolmaster, etc.,"<sup>2</sup> and in the articles and conditions to emigrants published by the Chamber at Amsterdam, section 8 says that "each householder and inhabitant shall bear such tax and public charge as shall hereafter be considered proper for the maintenance of comforters of the sick, schoolmasters, and such like necessary officers."<sup>3</sup>

Later than this, in the conditions offered to the settlers in the colony of New Castle on the Delaware in 1656, a "house for a school" was authorized, and they obligated to "pay the salary of a minister and school-master."<sup>4</sup>

<sup>1</sup> Hazard: *Annals of Pennsylvania*, 53.

<sup>2</sup> Quoted by Wickersham, *Education in Pennsylvania*, 8.

<sup>3</sup> *Ibid.*

<sup>4</sup> *Ibid.*, 9.

These citations are sufficient to show the importance attached to education at this early period, and to indicate that the church and education were considered together.

The Dutch and Swedes continued their private schools long after the accession of the English to the province.

## PENN'S CHARTER.

The Charter and Frame of Government, granted by William Penn seemed to promise more vigorous measures in regard to education; especially as it was placed under the control of the Assembly. Yet the Assembly was slow to give any direct support to education.

The twelfth article of the Frame of Government grants: "That the governor and provincial council shall erect and order all public schools and encourage and reward the authors of useful sciences and laudable inventions in the said province."<sup>1</sup>

Although there is much in this for the encouragement of public education, there is no provision for its support. The General Assembly interpreted it accordingly, and in the second General Assembly, convened in 1683, a general law was passed making it obligatory for parents and guardians to educate the children in their charge.<sup>2</sup> But the first school established by the Provincial Council was opened in the same year by Mr. Enoch Flower as a legally established private school.

The act passed on the 26th of October, 1683, is as follows:

"The Governor and Provincial Council having taken into their serious consideration the great necessity there is of a School Master for ye instruction & Sober Education of youth in the towne of Philadelphia, sent for Enoch Flower an inhabitant of the said town who for twenty year past hath been exercised in that care and employment in England, to whom having communicated their minds, he embraced it upon the following terms: to learn to read English 4s by the Quarter, to learn to read and write 6s by the Quarter; to learn to read & write and cast accounts 8s by the Quarter; for boarding a scholar that is to say diet, washing, lodging and schooling ten pounds for one whole year."<sup>3</sup>

By William Penn's instruction a public grammar school was opened in 1689, and formally chartered in 1697.<sup>4</sup>

This was a school of high order, in which the classical languages were taught, and corresponded to the New England grammar school of the early period. It was not "free" in the modern sense, but open to all persons, and granted special privileges to the poor. This is said to be the origin of the famous "Friends' Public School," which was chartered in 1697, rechartered in 1701, and again in 1711.

In the petition for this school, directed to the Governor and Council,

<sup>1</sup> Colonial Records, I, 27, introduction.

<sup>2</sup> Chap. 112, Duke of York's Laws, p. 142.

<sup>3</sup> Col. Rec. I, 36.

<sup>4</sup> *Ibid.*, 432.

the petitioners stipulate to instruct the "rich at reasonable rates, and the poor to be maintained and schooled for nothing."<sup>1</sup>

The charter of 1711 granted to this school is among the important early documents. The preamble begins as follows:<sup>2</sup> "Whereas, The prosperity and welfare of any people depend, in a great measure, upon the good education of youth and their early instruction in the principles of true religion and virtue, and qualifying them to serve their country and themselves by breeding them in reading, writing, and learning of languages and useful arts and sciences suitable to their sex, age, and degree, which can not be effected in any manner so well as by erecting public schools for the purposes aforesaid."

Although this approached the nearest to our present conception of a public school of all early institutions in Pennsylvania, yet it was in reality a private school, with certain agreements on the part of the corporate body to educate free of charge the children of the poor.

As a monument of early education it stands pre-eminent above other schools, and no other for the next fifty years following its establishment approached so near to the position of a state school.

As a fact, the provincial authorities did very little in providing for the education of the people prior to the Revolution. Their work was principally legalizing the actions of the church organizations and private bodies into whose care it intrusted the education of the youth of the province.

The school established by Benjamin Franklin in 1753 may be considered a legitimate outcome of the ideas of Penn and of the Friends' Public School, and to this period must we go for the real beginning of state education.

#### SCHOOL LEGISLATION.

Aside from the establishment of the academy and charitable school of the province of Pennsylvania at Philadelphia it may be stated that the first legislation in favor of state education began with the beginning of the Commonwealth.

The Constitution adopted in 1776 is the earliest constitutional provision on record among the States for the maintenance of a university, although other States through legislative enactment were far in advance in the support of higher education; North Carolina followed in the same year with a similar section in its first Constitution.

Article 44 of the Pennsylvania Constitution of 1776 declares as follows: "A school or schools shall be established in each county by the legislature, for the convenient instruction of youth, with such salaries to the masters paid by the public, as may enable them to instruct youth at low prices. And all useful learning shall be duly encouraged and promoted in one or more universities."<sup>3</sup>

<sup>1</sup> W. Ker-sham, 43.  
<sup>2</sup> *Ibid.*, 44.

<sup>3</sup> Poore, Charters and Constitutions, 1547.

The law was modified in the Constitution of 1790 so as to read:

(1) "The Legislature shall, as soon as conveniently may be, provide, by law, for the establishment of schools throughout the State in such manner that the poor may be taught gratis.

(2) "The arts and sciences shall be promoted in one or more seminaries of learning."<sup>1</sup>

These two sections were repeated word for word in the Constitution adopted in 1838.

These principles, formulated in the Constitutions of the Commonwealth, have led to a distinctive policy in state education.

The early colleges were endowed with a view to furnish teachers for the lower grade of schools. In a general sense this was the right view to take, for the higher educational institutions do determine the character of the lower; but in a special sense the higher institutions may not fit a person for the profession of teaching. Moreover, if the higher institutions react upon the lower, it is also true that the latter are necessary for efficient work in the former. The circle of education must be complete to ensure success. As Mr. Stevens well says, in his plea for free schools before the General Assembly in 1838, "Nor does it seem possible to separate the higher from the lower branches of education without injuring, if not paralyzing, the prosperity of both. They are as mutually dependent and necessary to each other's existence and prosperity as are the ocean and the streams by which it is supplied. For while the ocean supplies the quickening principles of the springs, they in turn pour their united tribute to the common reservoir, thus mutually replenishing each other."<sup>2</sup>

The bill that Mr. Stevens advocated at this session was passed in 1838, and was to remain in force for ten years. The clause pertaining to higher education is as follows: "To each university and college now incorporated, or which may be incorporated by the legislature, and maintaining at least four professors, and instructing constantly at least one hundred students, one thousand dollars; to each Academy and Female Seminary, now incorporated, or which may be incorporated by the legislature, maintaining one or more teachers, capable of giving instruction in the Greek and Roman classics, mathematics, and English, or English and German literature, and in which fifteen pupils shall constantly be taught in either or all of the branches aforesaid, three hundred dollars; to each of said Academies and Female Seminaries, where at least twenty five pupils are taught as aforesaid, four hundred dollars; and each of said Academies and Female Seminaries, having at least two teachers and in which forty or more pupils are constantly taught as aforesaid, five hundred dollars."<sup>3</sup>

The establishment of academies and seminaries was the direct result of the ideas entertained by Penn in his Frame of Government for the

<sup>1</sup> Constitution of 1790, Art. VII, secs. 1 and 2.

<sup>2</sup> Laws of 1837-38, 331.

<sup>3</sup> Quoted in Wickersham, 337.

be equally divided among the eight senatorial districts of the State, and distributed as before. This remained a law until the adoption of the new Constitution in 1846, which provided for a return to the old method.

There was no well-organized plan for determining the basis of apportionment until 1866, when examinations were instituted, certificates issued, and reports to the regents made accordingly. In 1870 the answer papers of these examinations were made returnable at the office of the regents, and were there subject to review and revision. The law of 1873 provides, among other things, that "no money shall be paid to any school under the control of a religious or denominational sect or society."<sup>1</sup>

The academies, under the protection of wise laws, increased rapidly in number and efficiency. In 1820 there were forty-eight academies to which charters had been granted, although only thirty reported for the apportionment. Besides the regular distribution of funds by the regents, amounting in the aggregate to about two millions of dollars, the Legislature has made at least sixty special grants of land and money for the benefit of academies. It is impossible within the scope of this work to give the specific grants of land or enter into the details of the separate acts of the Legislature. At least fifty thousand dollars have been granted from time to time to academies in need of immediate assistance, while it is difficult to estimate the money value of the numerous special land grants that have been made by the Legislature.

The amount of appropriation varied from year to year until 1830; then it was uniform till 1834, being ten thousand dollars annually. From 1835 to 1838 it was twelve thousand dollars per annum, and from 1839 to 1887 it has been forty thousand dollars per annum. By an act passed in 1887 the sum of sixty thousand dollars was added to the annual appropriation to academies, making the total appropriation from that time at the rate of one hundred thousand dollars annually. Of this amount twelve thousand dollars is taken from the income of the Literature Fund and twenty-eight thousand dollars from the United States Deposit Fund, and sixty thousand dollars from the General Fund.

The State also has appropriated three thousand dollars annually from 1835 to 1883, and six thousand dollars annually since 1884 to be granted by the regents to the academies under their visitation for the purchase of books and apparatus, on the condition that the academies should raise an equal sum from sources independent of their school property. From the excess of applications over the sum appropriated the regents have limited the applications to one hundred and fifty dollars each, and restricted them to alternate years.

The regents also have promoted the maintenance of classes in the academies under their visitation for instruction of common school

<sup>1</sup>Laws of 1873, sec. 7, p. 997.

teachers. This system was begun in 1834, and the appropriations sustaining it were derived from the United States Deposit Fund. The sum now appropriated is thirty thousand dollars annually, but the part of this sum actually paid out by the regents depends on the amount of service rendered. The academies are paid one dollar for the instruction of each scholar for each week. The classes are limited to twenty-five members, and continue from ten to thirteen weeks. An inspector is employed, who spends his whole time in visiting and caring for these classes. He is paid from the fund appropriated by the Legislature for the support of these classes.

The total amount of money distributed by the board of regents for academies from 1793 to 1884, inclusive, has been \$1,996,738.18, and to 1888 at least \$2,156,738.18.

#### THE REGENTS OF THE UNIVERSITY OF THE STATE OF NEW YORK.

The act of the Legislature of 1787 created a board of regents, whose specific duties were to care for Columbia College, and to incorporate and supervise such other colleges and academies as they might think proper. However, they were soon at the head of the entire educational department, and were advocating the establishment of a system of common schools, academies, and colleges. It was finally considered that the regents had to supervise only higher education, and to support literary and scientific institutions.

The University of the State of New York is far from being a fiction, although the regents have not chartered all of the educational institutions of the State or entered into the internal supervision of the colleges and academies belonging to the University; nevertheless, by general superintendence and especially by the control of incorporation they have added unity and strength to the schools of the State. Perhaps their greatest service has been in fixing the standard of requirements for incorporating colleges and academies, and bringing academies to a higher grade, by making the appropriations depend either upon the number of pupils, or the number of students pursuing classical studies and the higher branches of learning, and determining the latter by an examination test.

Early in the history of the board of regents, academies and colleges were not granted charters unless a certain amount of property had been secured and there were good indications that the proposed institutions would receive sufficient support.

#### RULES FOR INCORPORATION.

"It was resolved on March 23, 1801, that in future no academy ought to be incorporated unless it appeared to the satisfaction of the regents that a proper building for the purpose had been erected, finished, and



# 180 FEDERAL AND STATE AID TO HIGHER EDUCATION.

## SUMMARY OF GRANTS AND APPROPRIATIONS.

### *William and Mary College.*

#### Royal grants:

|                                                                  |        |
|------------------------------------------------------------------|--------|
| 1693—Quitrents and money .....                                   | £4,000 |
| 1693—Tax on tobacco exported, one penny per pound.               |        |
| 1693—All profits arising from fees in surveyor-general's office. |        |
| 1693—Twenty thousand acres of land.                              |        |

#### General Assembly grants:

|                                                                                        |          |
|----------------------------------------------------------------------------------------|----------|
| 1693—Tax on goods, wares, and merchandise imported.                                    |          |
| 1714—Money appropriations (about \$3,333) .....                                        | £1,000   |
| 1726—Tax of one penny per gallon on imported wines, rum, etc., per annum               | £900     |
| 1734—Tax of one penny per pound on tobacco exported into North Carolina from Virginia. |          |
| 1750—Tax on licenses to peddlers, on each £3.                                          |          |
| 1784—Grant of "palace lands" in Williamsburg and James City.                           |          |
| 1866—Special money appropriation .....                                                 | \$10,000 |
| Total, about .....                                                                     | 50,000   |

### *University of Virginia.*

|                                                            |           |
|------------------------------------------------------------|-----------|
| 1816—Globe lands donated to Albemarle College.             |           |
| 1818-1876—\$15,000 per annum (except 1861-65) .....        | \$935,000 |
| 1876-1884—\$20,000 per annum .....                         | 240,000   |
| 1884-1890—\$10,000 per annum .....                         | 200,000   |
| 1884—For improvements on buildings, etc. ....              | 40,000    |
| 1893—Special appropriation for library and apparatus ..... | 50,000    |
| 1893—Special appropriation for buildings .....             | 32,000    |
| Total to University of Virginia .....                      | 1,397,000 |

### *Virginia Military Institute.*

|                                                 |           |
|-------------------------------------------------|-----------|
| 1841-1850—Annual appropriations, \$9,100 .....  | \$177,000 |
| 1850-1859—Annual appropriations, \$15,000 ..... | 450,000   |
| 1841-1850—Special appropriations .....          | 136,500   |
| Total to Virginia Military Institute .....      | 763,500   |
| Total State appropriations .....                | 2,101,400 |

### *Hampton-Sidney College.*

1781—Land grant of 412 acres.

### *Hampton Normal and Agricultural Institute.*

|                                    |          |
|------------------------------------|----------|
| Total special appropriations ..... | \$30,000 |
|------------------------------------|----------|

### *Virginia Agricultural and Mechanical College.*

|                                    |           |
|------------------------------------|-----------|
| Total special appropriations ..... | 96,100    |
| Grand total .....                  | 3,550,500 |



West Virginia University.<sup>1</sup> In addition to the fund arising from the land sales, now about ninety thousand dollars,<sup>2</sup> ten thousand dollars were granted for an endowment in 1868, and an equal amount in 1871. Including the appropriation for 1887, twenty-one thousand dollars,<sup>3</sup> the State has granted the university \$278,926.90.

As these figures indicate, the attitude of West Virginia toward the higher education has been favorable and her support liberal.

## MARYLAND.

### EARLY HISTORY.

There was a proposal in the Legislature of Maryland in the year 1671 to establish a school or college. A bill was framed and passed in the Upper House of the Assembly, entitled "An act for the founding and erecting of a school or college within this province for the education of youth in learning and virtue."<sup>4</sup> The Lower House returned the bill to the Upper with certain amendments attached, which were not accepted by that body, and hence the bill never became a law.

Nothing more was done by Maryland for the next twenty years toward the establishment of schools within her borders. At the expiration of this time Governor Nichols prepared a plan for a free school (i. e., a liberal or Latin school). He communicated his plan to the Assembly in his message of 1694. The proposed school was to be organized and controlled by the Legislature, but its financial support was to be derived from subscriptions. The Governor himself offered a liberal donation, and requested the members of the Assembly to give as they felt able. Thereupon, the members of the House of Burgesses subscribed forty-five thousand pounds of tobacco in behalf of the new enterprise.

In the same year (1694) the Assembly passed an act for the maintenance of free schools in the province by laying a tax on furs, beef, bacon, and other exports of the colony. From this time, for thirty years, nearly the entire support of the free schools was derived from the taxation of exports and imports.

A law was at this time also passed for the encouragement of learning, embodying in its sections provision for the support of schools, but it was repealed two years later, in 1696. At this date a petitionary act was passed by the General Assembly of Maryland, praying for the establishment of a free school or schools.<sup>5</sup>

<sup>1</sup>Laws, extra session of 1868, 71.

<sup>2</sup>Report of the Commissioner of Education for 1896-97, 670.

<sup>3</sup>*Ibid.*, 661.

<sup>4</sup>Archives of Maryland, edited by Dr. William Hand Browne.

<sup>5</sup>Laws of 1696, chap. 17.

## KING WILLIAM'S SCHOOL.

This act provided for the founding of a school at "Anne-Arundel town," or Severn, later Annapolis, to be called King William's school, and its purpose was the education of youth in "Latin, Greek, and writing." The school was to consist of one master, one usher, one writing teacher, and one hundred scholars. It was to be under the control of a board of trustees empowered to hold lands valued at fifteen hundred pounds sterling, and to hold gifts and other property in trust. These trustees were, moreover, authorized to raise one hundred and twenty pounds sterling annually for the payment of the master's salary and for other expenses.<sup>1</sup> The trustees were created a body politic, to comprise not less than eighteen nor more than twenty members, who had authority to make such laws and regulations as seemed necessary for the control of the school, provided they were in accordance with the laws governing the province.

The school was to be supported by donations, and as soon as these amounted to one hundred and twenty pounds in excess of what was required to support the school at Severn, a second one, similar to the first, was to be established at Oxford, a neighboring county seat. This was the foundation of the county school system of Maryland. The institution at Severn received but little encouragement, although some donations were made, the chief of which was the gift of a house and lot in the city of Annapolis from Governor Nichols in the year 1715.<sup>2</sup>

## ESTABLISHMENT OF COUNTY SCHOOLS.

General dissatisfaction as to school management brought about a general educational reform and alteration of existing school laws in 1723. An act of the Assembly in this year provided for the establishment of at least one school in each county, and created a board of seven visitors for each school, who were to control the same. This board was further empowered to purchase for each county school one hundred acres of land, and this land was to be used partly for building-sites and partly for the support of the master. The funds on hand, as well as those obtained by taxation, were to be distributed equally among the twelve counties, later among the thirteen counties, and subsequently applied by the several boards of visitors to the direct needs of the schools.

The schools themselves were modelled after the plan of King William's School at Annapolis, and included the study of Latin and Greek in their course. The Assembly, by the same act,<sup>3</sup> together with other acts,<sup>4</sup> provided for the support of the free county schools. By these

<sup>1</sup> Laws of 1709, chap. 17, § 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100.

<sup>2</sup> Laws of 1715, chap. 17, § 1, 2.

<sup>3</sup> Laws of 1723, chap. 17.

<sup>4</sup> Laws of 1709, chap. 11.

<sup>5</sup> Laws of 1704, chap. 27; Laws of 1763, chap. 28.

provisions of the Legislature the following duties were laid on exports: on dried beef or bacon, twelve pence per pound; on pork or beef undried, twelve pence per barrel. On imported goods, for sale by non-residents, were laid the following duties: pork per barrel, one shilling; pitch per barrel, one shilling; tar per barrel, six pence.

A tax of twenty shillings per poll was also levied on all negroes<sup>1</sup> imported by land or water, and on "all Irish<sup>2</sup> servants being papists;" and there was an additional tax on all negroes exported by land or water to the extent of forty shillings in currency per poll. The proceeds of all fines, licenses, forfeitures, and escheated estates also augmented the general school fund.

Notwithstanding this apparently well-established system the county schools did not flourish. In some counties their support was not sufficient, and in others they failed for lack of well-directed effort. Nevertheless they made a beginning, and laid the foundation for a better system.

A plan for founding a college at Annapolis to educate the youth of the province was presented in 1732 for the consideration of the Governor and General Assembly. Instruction in theology, medicine, and the higher branches was included in the scope of instruction, but, as the plan was not accepted, the proposed college was not founded.

#### FOUNDING OF WASHINGTON COLLEGE.

For nearly a hundred years the one system of education within Maryland's borders was that of the county schools, some of which furnished only moderate advantages. But in 1782 there was a change for the better; the visitors of Kent County, representing that their county school at Chestertown was in a flourishing condition, petitioned the Legislature for the enlargement of the school into a college. Accordingly the Assembly passed a law, at the session of 1782, founding a college at Chestertown to be known as Washington College.

This was the beginning of a new era in education, and led to a system which, if it had been thoroughly carried out, would have early given education a renown to the State of Maryland. The preamble of the act establishing Washington College begins as follows:

"Whereas, Institutions for the liberal education of youth in the principles of virtue, knowledge, and useful literature, are the highest benefit to society; in order to raise up and perpetuate a succession of able and honest men, fit for discharging the various offices and duties of the community, both civil and religious, with usefulness and reputation, and such institutions of learning have accordingly merited and received the attention and encouragement of the wisest and best regulated states; and whereas, former Legislatures of this State have, according to their best abilities, laid a considerable foundation in this good work in sundry laws for the establishment and encouragement of county schools

<sup>1</sup> Laws of 1717, chap. 19.

<sup>2</sup> Laws of 1728, chap. 8.

for the study of Latin, Greek, and writing and the like, intending, as their future circumstances might permit, to engraft or raise on the foundation of said schools more extensive seminaries of learning by erecting one or more colleges or places of universal study, not only in the learned languages, but in philosophy, divinity, law, physie, and other useful and ornamental sciences, etc., etc."<sup>1</sup> Then follows an act of incorporation, creating a board of visitors or trustees, with the power to make rules for the government of the college, and the laws and regulations made by this body were furthermore to be laid before the Assembly for revision when the members so required.

The General Assembly was not only generous in founding the institution, but provided also for its future support. Large sums of money had been given by the citizens of the Eastern Shore toward this object, "and the Legislature having heretofore unanimously resolved that such exertions for the public good merited the approbation of the Legislature, and ought to receive the public encouragement and assistance," it was enacted by the General Assembly that one thousand two hundred and fifty pounds per annum should be paid from the public treasury for the support of Washington College. In order to raise this special fund, all the public receipts from the granting of marriage licenses, ordinary licenses, fines, licenses for the sale of spirituous liquors, licenses for hawkers, and fines for breaking the Sabbath were to be paid into the general fund for supporting the college.

## ST. JOHN'S COLLEGE.

The founding of this college was similar to that of Washington College. The same reasons existed for its establishment, and like views concerning it were expressed by the legislators. It was urged that King William's School was insufficient to meet the demands for education at that time, and that the West Shore, as well as the Eastern Shore, was in great need of an institution of higher grade. The General Assembly granted a charter to St. John's College in 1784,<sup>2</sup> the act of the grant being almost identical with that of Washington College. The Legislature granted four acres for college grounds and buildings, and authorized a committee to take subscriptions for the institution.

As in the case of Washington College, the Legislature provided for the permanent support of this institution. This is an extract from the act: "And to provide a permanent fund for the further encouragement and establishment of said college on the Western Shore, *Be it enacted, That* the sum of £1,750 (\$4,666.66) current money be annually and forever hereafter given and granted as a donation by the public to the use of said college on the Western Shore, to be applied by the visitors and governors of the said college for the payment of salaries to the principal, professors and tutors of the said college."<sup>3</sup>

<sup>1</sup>Laws of 1782, Chap. VIII.

<sup>2</sup>Laws of 1784, chap. 37.

<sup>3</sup>Laws of 1784, chap. 37, sec. 19.

Students of all denominations were admitted without any religious or civil test, nor were they compelled to attend religious worship. The institution was thus founded upon what men would now call extremely liberal principles.

In the same year that witnessed the founding of St. John's College, the Legislature took one step farther toward the realization of a great system of State education. They created the University of Maryland; the two colleges, Washington and St. John's, were united under one government, known as the University of Maryland. The Governor of the State was appointed chancellor, and the president of one of the colleges vice-chancellor of the University.<sup>1</sup> The visitors or governors of the two colleges, together with two members of each faculty, constituted the convocation of the University of Maryland. The convocation was to be called by the Governor of the State on Commencement Day, and was to be presided over by the chancellor. Thus was inaugurated a State policy of education which, had it been carried out, would have been of great service to the State of Maryland in early times, giving unity and strength to her educational system.

#### PUBLIC APPROPRIATIONS WITHDRAWN.

But the policy of dispersion of bounty which has been so detrimental to the interests of the State soon began. Had the original plan been carried out, Maryland might have had two efficient and well endowed colleges, and in every county one first-class academy; but, unfortunately, the best educational interests of the State have always been subordinated to local demands and county prejudices.

In 1794 five hundred pounds were withdrawn<sup>2</sup> from the amount "granted annually forever" to Washington College, and the income of said fund was henceforth devoted to the support of the following academies, called in the act, "seminaries of learning": (1) Washington Academy, Somerset County; (2) Charlotte Hall; (3) Frederick County School; (4) Talbot County Academy, not yet chartered; (5) an academy to be erected in Baltimore or Harford County. This was the historic origin of the academic donations still given in one form or another to the several counties by the State.

An act of 1805 destroyed for the time being the entire original plan for State aid to higher education. These are the fatal words: "The sum of seven hundred and fifty pounds now appropriated by law to Washington College, and the sum of seventeen hundred and fifty pounds appropriated by law as the annual donation to St. John's College, are, respectively, discontinued after June 1, 1805, and the said sum shall remain in the treasury subject to the appropriation of the Legislature to literary purposes and for disseminating learning in the different counties of the State."<sup>3</sup> With the same act the University of Mary

<sup>1</sup> Laws of 1774, chap. 37, sec. 19.  
<sup>2</sup> Laws of 1805, chap. 56.

<sup>3</sup> Laws of 1796, chap. cvil.

land ceased to exist, and with it all really generous State aid to colleges.

In 1811, six years after taking from St. John's College the endowment "granted annually forever" to that institution, the Legislature sought to make a meager restitution of the misappropriated funds by passing a resolution granting the sum of one thousand dollars to the college annually,<sup>1</sup> and in the year 1832 this annual grant was raised to three thousand dollars.<sup>2</sup> The Legislature also declared that this should be received by the said institution as full satisfaction for its claims on the State.

The court of appeals decided in 1859 that the action of the Legislature in regard to the endowment was a violation of contract, and that the institution could collect the sum due it from the State.<sup>3</sup> The General Assembly added, in 1832, as *ex-officio* members of the board of visitors and governors, the Governor of the State, the President of the Senate, the Speaker of the House, and the Judges of the Court of Appeals.

St. John's College was suspended during the War of the Rebellion, but was reorganized in 1866, at which time the Legislature voted to restore the annuity of three thousand dollars,<sup>4</sup> and to grant the sum of one thousand two hundred dollars annually for five years commencing with June, 1868. The latter provision was renewed in 1872<sup>5</sup> for a term of six years, and again in 1878 it was extended to 1880. It was also provided in 1872 that the sum of ten thousand dollars per annum, for five years, should be devoted to the payment of the board of fifty students, two from each senatorial district. And in consideration of the above gifts there were granted one hundred and fifty free scholarships, which entitled the holders to tuition and room rent. Fifty of these students also received board on the condition that they pledged themselves to teach two years in the State after graduation. One very sensible appropriation at this time was that of five hundred dollars for the library.

In 1878 the number of students entitled to receive free board was twenty-five, one from each senatorial district, and the amount appropriated for this purpose was cut down to six thousand dollars for 1878-79, and was fixed at five thousand two hundred dollars for the following years.

The amount received in 1888 by St. John's from the State was the annual grant of three thousand dollars, together with the five thousand two hundred dollars granted for boarding the twenty-five pupils, one from each senatorial district.

#### THE COUNTY SCHOOLS.

The system of county schools and academies continued, and these institutions were still supported from the general funds. Many of them were favored by small land grants, while others were aided by means

<sup>1</sup> Laws of 1811, resolution No. 38.

<sup>4</sup> Laws of 1866, chap. 191.

<sup>2</sup> Laws of 1832, resolution No. 41.

<sup>5</sup> Laws of 1872, chap. 393.

<sup>3</sup> XV Maryland, p. 339.



of lotteries<sup>1</sup> granted by the State. But in most cases the buildings and grounds were provided by local taxation, or by subscriptions and donations, and the support given by the State out of the public fund was very meager.

In 1817 it was ordered by the Legislature "that, for the income of the school fund of this State," fifty thousand dollars shall be raised annually, for five years, by means of lotteries if practicable. It seems that the enterprise proved impracticable, for no such sum as that contemplated was ever credited to the school fund.

Washington Academy, established in Somerset County in 1779, may be considered as a good example of the schools of that time. The act of incorporation begins, "*Whereas*, the inhabitants of Somerset County at their own expense have provided houses, lands, etc., *Be it enacted*," etc. The corporation was allowed to hold fifteen hundred acres of land by gift and five hundred additional by purchase; and, in 1803, the State granted a lottery to the academy to aid in furnishing the school.

In 1814 the Legislature enacted<sup>2</sup> that after 1815 the banks should be taxed one fifth of one per cent. on all paid up capital for the support of county schools, and the same be distributed to the counties.

For a time this fund yielded the sum of twenty thousand dollars annually, which was invested in bank stock. This was an important step toward a school system, inasmuch as it created a permanent fund.

In 1825 there was added to this fund the interest on the amount advanced to the General Government by Maryland during the War of 1812. The share of the surplus revenue received by Maryland in 1836, amounting to \$274,451, was deposited with the Educational Fund, and the interest of the sum used for the schools of the several counties and the city of Baltimore.

In 1841 the revenue arising from the Baltimore and Washington Railroad stock was substituted for this fund, to the amount of \$34,069 annually. Instead, however, of holding this, an unwise provision distributed this principal instead of the interest to the different counties. After spending in an indefinite way without any well-founded school policy, the Legislature gave a pittance here and there, and in various ways assisted the local institutions of the different counties.

The principal fund was increased in 1858 by the amount of \$173,559, principal and interest of the sum due from the General Government on account of the war debt of 1812. Lotteries were repeatedly employed for the purpose of raising money for school purposes. In 1809 a law was passed author-

the nineteenth century, all of the non-valent enterprises in Maryland patronized the same places, schools, and churches all used this means for raising money for good works. The custom was of long standing, and spread to the country.

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11. 10. 1991. 224.

izing a lottery not exceeding twenty thousand dollars, the proceeds to be applied to the building of a commodious house within the precincts of Baltimore adapted to the purpose of an academy and for the education of females.

By the treasurer's report of 1834, the sum of \$18,100 was paid by the State to twenty-eight different colleges and academies. Of this amount St. John's College received three thousand dollars, Frederick College two thousand four hundred dollars, Washington College eight hundred dollars, and the remainder was given to the several county schools and academies.

## UNIVERSITY OF MARYLAND.

The old University of Maryland<sup>1</sup> having been discontinued, a new institution under the same title was incorporated in 1812. It was to be in Baltimore, and to consist of the college of medicine,<sup>2</sup> a faculty of law, a faculty of divinity, and a faculty of the arts and sciences. In the year following, a lottery was granted by the State for the benefit of the University of Maryland to provide a library, botanical garden, and scientific apparatus. It was also ordered, in 1827,<sup>3</sup> that five thousand dollars per annum should be paid to the trustees of the University of Maryland, out of the "next proceeds" of the State lotteries, until the total amount of \$40,994.06 was paid. According to the treasurer's report for 1834, the university had received from this source the sum of \$30,500.<sup>4</sup>

Two faculties of the University of Maryland, one of law and one of medicine, still continue in the city of Baltimore.

In 1803 Baltimore City College was founded, and in the same year all educational institutions were for the future exempted from taxation.

## MARYLAND AGRICULTURAL COLLEGE.

Public sentiment in favor of special education in agriculture was exhibited as early as the year 1845. At that time the board of governors and visitors of the Frederick County Academy established a department of agriculture, and appointed an agricultural chemist.

In 1847 Hon. George Coad, chairman of the Committee on Agriculture in the House of Delegates, recommended in his report<sup>5</sup> the appointment of a State Agricultural Chemist, and expressed the hope that there would soon be "courses of agricultural education in the public academies and schools, or schools for the special purpose established."<sup>6</sup> In 1848 Col. Wilson M. Cary urged before the first anniversary meeting of the Maryland State Agricultural Society the necessity of profes-

<sup>1</sup>Laws of 1803, chap. 71.

<sup>2</sup>Organized in 1807.

<sup>3</sup>Laws of 1827, chap. 198.

<sup>4</sup>Maryland Public Documents, 1834.

<sup>5</sup>Report of the Commissioner of Education for 1867, 273.

sional education for farmers, and the "introduction of those studies immediately connected with their pursuit into our colleges and seminaries."

Subsequently, Dr. White introduced before the House of Delegates a proposition to inquire into the expediency of agricultural instruction in the academies of the State. The question was further agitated in 1854, and in 1856 the Legislature was memorialized by a company of citizens of Maryland for the establishment and endowment of a State agricultural college. The Legislature granted a charter upon the condition that not less than fifty thousand dollars should be raised by a stock subscription within two years.<sup>1</sup> This body also voted to grant six thousand dollars annually toward paying the expenses of the institution. The subscription was raised, and a farm of four hundred and eighty acres was purchased in Prince George County, and buildings were erected at a total cost of about one hundred thousand dollars. The college was opened for students in 1859, but very little was accomplished until after the War.

In 1866, the Legislature assumed the debt of the institution to the amount of forty five thousand dollars, and assigned to it the United States land scrip received by the grant of 1862. By the latter act Maryland received two hundred and ten thousand acres, which were sold at an average price of fifty-three cents an acre, yielding a net sum of \$112,504. When the Legislature assumed the debt of the college the State was made a joint owner in the institution with the old corporation. And when the land scrip was granted to the college by the State, ten per cent. of the amount (\$11,250.40) was "reserved, to be paid into the treasury of the State, to reimburse the said State in part for the amount appropriated by this act to the Maryland Agricultural College."<sup>2</sup> This deduction left a fund of about \$101,000, which in 1868 yielded an income of \$6,975, and in 1882 of \$6,975.<sup>3</sup> In the year 1881 the Legislature made an annual appropriation of \$6,000 for the support of the college.

#### SUMMARY OF GRANTS

##### *First support of schools.*

|      |                                                                                   |       |
|------|-----------------------------------------------------------------------------------|-------|
| 1641 | 1. The colony, wheat, bacon, etc., exported, for the support of free schools..... | ..... |
| 1700 | 2. The colony, authorized to purchase 100 acres of land for each township.....    | ..... |
| 1703 | 3. The colony, authorized to purchase 100 acres of land for each township.....    | ..... |
| 1704 | 4. The colony, authorized to purchase 100 acres of land for each township.....    | ..... |
| 1705 | 5. The colony, authorized to purchase 100 acres of land for each township.....    | ..... |
| 1706 | 6. The colony, authorized to purchase 100 acres of land for each township.....    | ..... |
| 1707 | 7. The colony, authorized to purchase 100 acres of land for each township.....    | ..... |
| 1708 | 8. The colony, authorized to purchase 100 acres of land for each township.....    | ..... |
| 1709 | 9. The colony, authorized to purchase 100 acres of land for each township.....    | ..... |
| 1710 | 10. The colony, authorized to purchase 100 acres of land for each township.....   | ..... |

<sup>1</sup> Laws of 1856, sec. 10. <sup>2</sup> Laws of 1866, chap. 53. <sup>3</sup> Report of Trustees, 1882.

*Washington College.*

|                                                |                 |
|------------------------------------------------|-----------------|
| 1782-1794.—Annual grant, £1,250 (£15,000)..... | \$52,500.00     |
| 1794-1805.—Annual grant, £750 (£8,250) .....   | 27,166.66       |
|                                                | <hr/> 79,666.66 |

*St. John's College.*

|                                                                 |                  |
|-----------------------------------------------------------------|------------------|
| 1784-1805.—Annual grant, £1,750 (£36,750).....                  | 122,500.00       |
| 1811-1832.—Annual grant, \$1,000 .....                          | 21,000.00        |
| 1832-1861.—Annual grant, \$3,000 .....                          | 87,000.00        |
| 1866-1879.—Annual grant, \$3,000 .....                          | 69,000.00        |
| 1886-1890.—Annual grant, \$12,000 .....                         | 192,000.00       |
| 1872-1878.—Annual grant, \$10,000 (education of students) ..... | 60,000.00        |
| 1879.—Annual grant, \$6,000 (education of students) .....       | 6,000.00         |
| 1890-1899.—Annual grant, \$5,200 (education of students) .....  | 46,800.00        |
| For library .....                                               | 500.00           |
| Total .....                                                     | <hr/> 652,300.00 |
| 1827.—University of Maryland, State lotteries .....             | 40,934.06        |
| State Agricultural College .....                                | 60,000.00        |

Grand total, exclusive of lotteries ..... 744,466.66

In the distribution of apportionments from the literary fund among academies, Washington and Frederick Colleges were included in the list. The amount of this distribution is not computed, as it pertains rather to secondary instruction.

NORTH CAROLINA.<sup>1</sup>

In the colonial and provincial periods of the development of the Commonwealth of North Carolina the government played a very unimportant part in the education of the people. The establishment as well as the support of schools was dependent almost entirely upon the zeal of religious denominations or the chance of private enterprise. It was not until the dawning of a new era, when North Carolina, emerging from the uncertainties of these early periods, took the position of an independent Commonwealth, that a self-governing people made their bold declaration for higher education in the Constitution of 1776.<sup>2</sup>

## COLONIAL LEGISLATION.

The first action toward the advancement of learning taken by the colonial government was in regard to the care of a library donated to the State by Dr. Bray. In reference to this action Dr. Smith says: "A careful examination of the records of the colony while under proprietary government shows only one instance in which help was afforded to literature. • • • This act provided that a librarian should be ap-

<sup>1</sup> See History of Education in North Carolina, by Dr. Charles Lee Smith.

<sup>2</sup> *Ibid.*, 1-.

<sup>3</sup> Laws of North Carolina, Davis's Revision, 203.

pointed, that catalogues should be prepared, and that, under certain conditions, books might be taken from the library. It was provided that if the books were not returned within a specified time fines should be paid. No further thought seems to have been given by the government for the promotion of education."

For many years during the provincial period nothing was done by the Legislature to promote education, although the country was not without schools. In 1736 the Governor, Gabriel Johnston, urged the importance of making some provision for public schools. He says in his address to the Assembly: "In all civilized Societys of men it has always been looked upon as a matter of the greatest consequence to their Peace and happiness to polish the minds of young Persons with some degree of learning, and early instill into them the Principles of virtue and religion, and that the Legislature has never yet taken the least care to erect one school which deserves the name, in this wide extended country, must, in the judgment of thinking men, be reckoned one of our greatest misfortunes."<sup>1</sup>

The members of the Council, in reply, expressed their regrets at the condition of the country in regard to religion and education.<sup>2</sup> Here the matter rested until nine years after, when the General Assembly passed an act authorizing the commissioners of the town of Edenton to "erect and build a school house in the said town."<sup>3</sup> This was followed by an act, in 1749, establishing the first free public school in the province.

These were legislative enactments; but how far and to what extent they were carried into execution is unknown. Judging from the message of Governor Johnston, quoted above, and a statement taken by Dr. Smith from Canthers's Life of Caldwell, that "he (Governor Johnston) knew the value of learning and wished to see it promoted; but when appropriations were made for it, they were either wasted or taken to meet some other demands of the treasury,"<sup>4</sup> one must infer that these legislative attempts at education were failures.

In 1700 Governor Dobbs recommended that the vestry in each parish should raise a sufficient sum to pay a person to act as parish clerk and register, school master, and reader, in the absence of the clergyman. The sum so raised was borrowed for military purposes and never returned. In the session of 1764, held at New Berne, the Legislature enacted that a school house and a residence for the master should be erected at that place, and located two half-lots formerly belonging to the church for these purposes. This government aid was effectual; the Newbern school was incorporated two years later as a result of this act of the Legislature. The school was to be "public," but largely under the control of the established Church of England. It was also provided in

<sup>1</sup> Journals of the Assembly of North Carolina, IV, 227.

<sup>2</sup> Smith, 21.

<sup>3</sup> *Ibid.*, 40.

the act of incorporation that a duty of one penny per gallon on all spirituous liquors imported into the river Neuse be paid for the term of seven years next following the enactment, toward the education of ten poor children of the school, the same to be applied toward the salary of the master (twenty pounds per annum).

From this time on, private, incorporated, and denominational schools were established in great number. The aid given by the government was very slight, being limited to the privilege of holding lotteries, with perhaps rare exceptions, as in the case of the grant by the Legislature of the old Episcopal Church to Science Hall at Hillsborough in 1784.

#### THE ORIGIN OF THE UNIVERSITY OF NORTH CAROLINA.

The foregoing sketch of early education prepares us for the presentation of the State legislation in favor of higher education, which must necessarily begin with the University of North Carolina. This institution has been called the "child of the Constitution," but it must have been prompted by earlier sentiments arising from the refusal of the King to charter Queen's College, which "was twice chartered by the Legislature and twice repealed by royal proclamation.<sup>1</sup> Revolting from this restraint, the people declared their independence by voting for that clause in the Constitution which made the university possible, viz: "That a school or schools shall be established by the Legislature, for the convenient instruction of youth, with such salaries to the masters, paid by the public, as may enable them to instruct at low prices; and all useful learning shall be duly encouraged and promoted in one or more universities."<sup>2</sup>

Thirteen years later this was followed by the Legislature with "an act to establish a university in this State,"<sup>3</sup> which made full and complete provisions for the organization of the university. The preamble to this act is quite remarkable, as it alludes expressly to the "social duties" of the rising generation, without mention of the specific duties of citizens or the service of the State. It states that, "*Whereas*, In all regulated governments it is the indispensable duty of every Legislature to consult the happiness of the rising generation and endeavor to fit them for an honorable discharge of their social duties of life by paying the strictest attention to their education, and *whereas*, an university supported by permanent funds and well endowed, would have the most direct tendency to answer the above purpose; *Be it therefore enacted*, etc."<sup>4</sup>

The act of incorporation then proceeded to place the sole power of establishing and controlling the university in the hands of forty

<sup>1</sup> Smith, 33.

<sup>2</sup> Constitution of 1776, sec. 41.

<sup>3</sup> Revised Laws of North Carolina (1821), Chap. 305, p. 606.

<sup>4</sup> Revised Statutes, p. 606, chap. 305.

trustees<sup>1</sup> selected from different parts of the State. The said trustees were to have perpetual succession and power to do anything "such as may be necessary for the promotion of learning and virtue."<sup>2</sup> They were further authorized to purchase a site and erect a building as soon as sufficient funds could be collected, and hold all subscriptions to the university "as a permanent fund for the use and support of the said university forever."<sup>3</sup>

#### APPROPRIATIONS FOR THE SUPPORT OF THE UNIVERSITY.

The act of incorporation passed in 1789, referred to above, was followed the same year by an act for the support of the institution. The Legislature did not accomplish much, but perhaps it did all that it was warranted in doing at this time, considering the poverty of the country and the hard strain of war. In order to raise a fund for the erection of buildings, all moneys due and owing the public of North Carolina, either for arrearages under the former or present government, up to the first day of January, 1783 (four years from date), were donated to the university. It was further enacted that "all property that has heretofore or shall hereafter escheat to the State shall be and hereby is vested in the said trustees for the use and benefit of the said university," and that all "lands and other property belonging to the university shall be exempt from taxation."<sup>4</sup> To assist in the erection of buildings, the State, in 1791, loaned the university ten thousand dollars, which loan was afterwards converted into a gift.<sup>5</sup>

The university received other assistance in its founding. The trustees had selected a site on Chapel Hill, and proceeded to lay out a town at that place. The citizens of the neighborhood conveyed to the institution 1,180 acres of land, and a subscription of sixteen hundred dollars in money.

The building was constructed, but the trustees were in want of funds to open the university. Realizing the situation, the Legislature enacted in 1794 that "Whereas, The trustees of the university of North Carolina have with laudable zeal for the promotion of literature erected a building for the use of the institution entrusted to them, and, are at the same time prepared to commence the exercises of the university, • • • the remnant of confiscated property remaining unsold is

It was enacted in 1794 that the trustees should be elected by the Legislature, and should not constitute more than eight from each superior court district. In the following year the Governor of the State was made *ex-officio* president of the board of trustees. Some years later a law was passed, in 1821, consolidating all previous acts, and providing that the board be composed of sixty-five trustees, elected by a joint ballot of the two Houses. Seven trustees were to constitute a quorum, and each meeting must be called by the president. It seems to be a large membership with a small quorum.

<sup>1</sup> Revised Statutes, chap. 26, sec. 5.

<sup>2</sup> *Ibid.*, chap. 26, sec. 6.

<sup>3</sup> Revised Statutes, 1821, chap. 36, p. 610.

<sup>4</sup> *Public Statutes of North Carolina*, 531.

vested in the trustees,"<sup>1</sup> to be held in trust for a term of ten years, when the principal was to revert to the State. This grant of escheats was withdrawn in 1800, and all escheated and confiscated property reverted to the State.<sup>2</sup> Again, in 1805, the last act mentioned was repealed as far as it related to escheated property. It is plain that the law of 1794 was suspended from 1800 to 1805, and that part relating to confiscated property finally repealed in 1800.

In 1801 the university was authorized to raise not over two thousand pounds a year by lotteries.<sup>3</sup> Two years later, \$5,080 profits were realized from lotteries.<sup>4</sup> Again, in 1809, the Legislature came to the relief of the university. It resolved that "in the present embarrassed state of the institution it is the bounden duty of the Legislature to afford it such assistance as the nature of the public finances will justify."<sup>5</sup> It was then enacted that the trustees of the university should hold and use all sums of money or other estate which should remain in the hands of administrators and executors seven years after their qualification, without recovery by creditors, legatees, or heirs. After the university had held the property for ten years without any just claimant thereto, it became the possession of the university. It was further enacted that all debts due the State on or before December 31, 1799, should be given to the university.

While this small legislation was taking place, the gifts of private benefactions, together with the tuition fees of the students, were supporting the institution. It is next to an impossibility to determine at this day the actual assistance rendered by the grants of the Legislature. Excepting the ten thousand dollar loan, which afterward became a gift, the returns from others were small, and the trouble which they caused the university authorities probably by far overbalanced their usefulness.

The very able report of the committee appointed by the Legislature in 1817, of which Hon. A. D. Murphy was chairman, throws some light upon university affairs. It says: "This institution has been in operation for twenty years, and has been eminently useful to the State. It has contributed perhaps more than any other cause to diffuse a taste for reading among the people and excite a spirit of liberal improvement. It has contributed to change our manners and elevate our character; it has given to society many useful members, not only in the liberal professions, but in the walks of private life, and the number of its pupils who are honored with seats in this Legislature is a proof of the estimation in which they are held by their fellow-citizens. When this institution was founded it was fondly hoped that it would be cherished

<sup>1</sup> Revised Statutes, 1921, chap. 407, p. 738.

<sup>2</sup> Haywood's Manual of the Laws of North Carolina, II, 259.

<sup>3</sup> Revised Statutes, chap. 573, p. 238.

<sup>4</sup> Smith, 59.

<sup>5</sup> Revised Statutes, chap. 763, p. 1152. Haywood, II, 206.



with pride by the Legislature. But unfortunately the nature of the funds with which it was endowed in a short time rendered it odious to some and cooled the ardor of others. The torrent of prejudice could not be stemmed, the fostering protection of the Legislature was withheld, and the institution left dependent upon private munificence. Individuals contributed not only to relieve its necessities, but to rear up its edifices and establish a permanent fund for its support. • • •

With the aid thus derived from individuals, together with occasional funds derived from escheats, the institution has been maintained thus far. The Legislature, after exhausting its patience in endeavoring to collect arrearages of debts due to the State, transferred to the trustees of the University those arrearages, with the hope that they would be able to enforce payment. But no better fortune has attended their efforts than those of the State, and this transfer has proved of no avail to the institution. The surplus remaining in the hands of administrators where the next of kin have made no claim within seven years have also been transferred to the trustees, but this has as yet yielded a very small sum, and probably never will yield much.<sup>1</sup>

The General Assembly made no further provision for the support of the State University until 1859. The Bank of North Carolina was then chartered, with a view to promote the interests of the University. The trustees were allowed to subscribe to an amount of stock not to exceed two hundred thousand dollars. The trustees subscribed, and lost through repudiation of the War debt by the convention of 1865, the State having previously secured the control of all bank property.<sup>2</sup>

The amount of the funds of the University over and above liabilities was \$148,520.26, which was entirely lost.

In 1866 the General Assembly granted the sum of seven thousand dollars for the relief of the institution, which, together with the sum granted in 1790, makes a total of seventeen thousand dollars, the entire amount appropriated for the support of the University from the public treasury prior to the date of 1867, during a period of eighty-eight years from the date of the charter.

A modification of one of the old laws was made in 1868-69 by an act which declares that property, money, or real estate of whatsoever kind, remaining in the hands of the executors for a term of five years unrecovered and unclaimed, shall revert to the University.<sup>3</sup> Another provision is found in the revised statutes enacted for the purpose of assisting the University, which declares that the proceeds of all unclaimed freight, if not returned to the owner within five years, shall revert to the University.<sup>4</sup>

Apparently, however, the Legislature is learning by degrees that a

<sup>1</sup> Report of Superintendent of Public Instruction (Alexander Melver), 1874, 90-91.

<sup>2</sup> Memorial by Governor Worth to the General Assembly, 1867.

<sup>3</sup> Laws of 1868-69, chap. 113, sec. 76.

<sup>4</sup> Revised Statutes, 1883, sec. 1907.

university can not be supported, nor even materially aided, by such gifts as the above, which are quite different from a constant income of twenty thousand dollars per annum.

#### THE AGRICULTURAL COLLEGE GRANT.

The State of North Carolina received two hundred and seventy thousand acres of land scrip from the grant of 1862. This scrip was transferred to the University in 1867 upon the condition that the terms of the grant should be fulfilled, and that one student from each county, appointed by the commissioners, should receive tuition and room-rent free at the University. The scrip was sold at fifty cents per acre, yielding the sum of one hundred and thirty-five thousand dollars, ten thousand dollars of which was devoted to building purposes.

In 1868 the trustees invested this fund of one hundred and twenty-five thousand dollars in State securities, part of which were valid, but bearing no interest, and part of which were worthless. In 1874 the Legislature came to the relief of the land-scrip fund, by directing the State treasurer to issue to the trustees of the University a certificate of indebtedness to the amount of one hundred and twenty-five thousand dollars, bearing interest at 6 per cent. per annum from January 1, 1875, the interest payable semi-annually. By an act of the Legislature in 1887 the interest arising from this fund was ordered to be transferred to the account of the Agricultural and Mechanic Arts College as soon as the college should be ready for use.

#### RECENT APPROPRIATIONS.

The General Assembly in 1881 appropriated the sum of five thousand dollars<sup>1</sup> annually for the support of the University, and in 1885 increased this amount to twenty-thousand dollars. The State has also made appropriations for the Agricultural and Mechanic Arts College to the amount of fifteen thousand five hundred dollars.

#### RESTRICTIVE LAWS.

Notwithstanding the constant vicissitudes and struggles of this noble institution for existence, its value to North Carolina and to the country at large has been and is very great. Its attitude toward advanced learning is such as to deserve the earnest support of all classes of people throughout the State. History reveals the fact, however, that the zeal of various denominations for the advancement of their several schools has more than once crippled the institution in its best work.

Sometimes it is urged against State institutions that they do not tend to increase morals and religion; but the precautions taken by the

<sup>1</sup> Revised Statutes, sec. 2677; Laws of 1881, chap. 111, sec. 1. This law provided for the application of the appropriation for the special instruction of teachers.

Legislature of North Carolina, prompted no doubt by the faculty and trustees, are quite remarkable.

It was provided in 1821 that theatricals should not be held within five miles of Chapel Hill without the consent of three members of the faculty.<sup>1</sup> Afterward this act was enlarged so as to prohibit wire dancing and the exhibition of natural or artificial curiosities.<sup>2</sup> No gaming table, should be set up within five miles of the University. No games of chance or billiards should be indulged in by the students. No horse-racing or cock-fighting should be indulged in by any one within five miles of the University under a penalty of one hundred dollars.<sup>3</sup> No election of a member of Congress was allowed to be held at the seat of the University,<sup>4</sup> and it was provided in the Revised Statutes of 1883 that it is against the law for persons to indulge in election treats within four miles of the University.<sup>5</sup>

No license could be granted for the sale of spirituous liquors at retail within 2 miles of the institution, and merchants were prohibited from selling goods, wines, or spirituous liquors to students within 2 miles. These laws were collated and modified somewhat, but are still extant in their principal points in the revised statutes of 1883. It seemed to be the policy of the State to remove far from the institution all evil influences, and all things calculated to distract the minds or injure the morals of students. On the other hand, the rules of the faculty and the trustees in regard to moral and religious duties exceed the action of the Legislature in rigid requirements.

#### SUMMARY OF GRANTS.

##### *University.*

|                                                     |          |
|-----------------------------------------------------|----------|
| In 1791, loan and fund gift .....                   | \$10,000 |
| In 1847, appropriation.....                         | 7,000    |
| Annual appropriation, 1851 to 1855 (\$5,000) .....  | 25,000   |
| Annual appropriation, 1855 to 1859 (\$20,000) ..... | 80,000   |
| Other appropriations (see below).....               | 223,000  |

##### *Agricultural College.*

|                     |           |
|---------------------|-----------|
| Appropriations..... | 15,000    |
| Total .....         | \$355,000 |

The following summary is kindly furnished me by the president of the University of North Carolina, Kemp P. Battle.<sup>6</sup>

(1) The State gave the university escheats of lands, including land warrants granted Revolutionary soldiers. The receipts for these came in slowly and spasmodically. The total amount received from this source is estimated at two hundred thousand dollars, of which one hundred and fifty thousand went into a permanent endowment, and

<sup>1</sup> Laws of 1821, chap. 22, p. 17.

<sup>2</sup> Revised Statutes (1857), chap. 116.

<sup>3</sup> Laws of 1823, chap. 33, p. 16.

<sup>4</sup> *Ibid.*, p. 17.

<sup>5</sup> Revised Statutes, 1883, sec. 3644.

<sup>6</sup> Letter dated March 4, 1909.

was lost by the results of the War. The remainder was spent in paying professors and for other current expenses.

(2) Ten thousand dollars in cash were appropriated for building purposes prior to 1800; fourteen thousand for the same purposes since 1800, and seven thousand in 1867 for paying professors.

(3) Four thousand dollars in bricks for building purposes.

(4) Five thousand dollars per annum from 1881 to 1885, or twenty thousand dollars.

(5) Twenty thousand dollars annually from 1885 to 1889, or eighty thousand dollars.

This would give a total appropriation to date of \$335,000. If we add to this sum \$5,080, the proceeds of two lotteries granted by law in 1803,<sup>1</sup> it swells the total to \$340,080, representing the State appropriations to the University of North Carolina.

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#### SOUTH CAROLINA.<sup>2</sup>

##### COLONIAL EDUCATION.

"It is a gratifying fact in the history of Carolina that as soon as the English settlers placed their feet upon its soil they gave the most earnest attention to the business of education."<sup>3</sup> The earnest example of this educational spirit is found in the formation of a public library at Charleston, which the Assembly in 1700 placed under the control of the Episcopal minister there resident.<sup>4</sup> From the first, education was assisted by public money. We find the Assembly providing for a free school as early as 1710.<sup>5</sup> This act did not go into operation in the form intended and was superseded two years later by more comprehensive legislation. By an act of December 12, 1712,<sup>6</sup> commissioners were designated to take charge of all legacies that had been left for a free school, to take up land in Charleston, and to build a school-house and houses for the teachers.

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---

<sup>1</sup> Smith, 59.

<sup>2</sup> See Education in South Carolina, by C. Meriwether. Circular of Information No. 3, 1888, Bureau of Education.

<sup>3</sup> La Border: History of South Carolina College, 1.

• <sup>4</sup> Statutes at Large of South Carolina, VII, 13. Ramsay: History of South Carolina, II, 196.

<sup>5</sup> Statutes at Large, II, 342. Report of the Commissioner of Education for 1876, 362.

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#### SUMMARY OF GRANTS.

##### *University.*

|                                              |          |
|----------------------------------------------|----------|
| In 1792, from the Legislature                | \$10,000 |
| In 1800, from the Legislature                | 7,000    |
| Annual appropriation, 1851 to 1859, \$4,000  | 20,000   |
| Annual appropriation, 1859 to 1859, \$20,000 | 40,000   |
| Other appropriations (see below)             | 23,000   |

##### *Agricultural College.*

|                      |                  |
|----------------------|------------------|
| Annual appropriation | 15,500           |
| <b>Total</b>         | <b>\$155,500</b> |

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<sup>4</sup> *Ibid.*, p. 17.

<sup>5</sup> Revised Statutes, 1853, sec. 2544.

<sup>6</sup> Letter dated March 4, 1899.

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<sup>2</sup> See Education in South Carolina, by C. Meriwether. Circular of Information No. 3, 1888, Bureau of Education.

<sup>3</sup> La Border: History of South Carolina College, 1.

• <sup>4</sup> Statutes at Large of South Carolina, VII, 13. Ramsay: History of South Carolina, II, 196.

<sup>5</sup> Statutes at Large, II, 342. Report of the Commissioner of Education for 1876, 302.

<sup>6</sup> Statutes at Large, II, 349. Ramsay, II, 197. Report of the Commissioner of Education for 1876, 302.

Greek tongues." He was to have the use of the land and buildings of the school and a salary of one hundred pounds a year, to be paid out of the public treasury, for which he was to teach twelve scholars free. For all others he was to receive four pounds a year. Provision was also made for an usher and for a master to teach writing and mathematics, each of whom was to have a salary of not over fifty pounds from the public treasury, besides fees from each scholar. It was enacted at the same time that any school-master settled in a country parish and approved by the vestry should receive ten pounds a year from the public treasury, and each vestry was permitted to draw from the same source twelve pounds towards building a school-house in each of the country parishes. This act repealed an earlier act of the same year, which had granted the school-master for the parish of St. James, Goose Creek, sixteen pounds a year from the public treasury.<sup>2</sup> In 1756 it was provided that the school-master at Dorchester should have yearly fifty pounds proclamation money out of the public treasury. In return for this he was to teach ten poor scholars free.<sup>3</sup>

Although these instances of public aid occur, education was largely carried on by private contributions. Sir Francis Nicholson, the first royal Governor, contributed to the support of education and urged its importance upon the inhabitants, and his influence is a partial explanation of the many private donations of this period. The activity of the Assembly was chiefly confined to forming centers, about which private donations might gather. By the end of the colonial period the various free schools gave the inhabitants of the province opportunity for instruction in the common branches and in the rudiments of Latin, Greek, and mathematics.

#### EARLY COLLEGES.

The colleges founded toward the close of the last century form a transition from the free or Latin schools of the colonial period to the South Carolina College. State aid was manifested in gifts of land for building sites, in permission to hold lotteries, and in grants of the escheated lands in certain districts. The last-mentioned form of aid was also frequent in the case of academies.

Legacies had been left at various times to the first college that should be founded. These were divided equally among the three colleges which the Legislature chartered in 1785.<sup>4</sup> These colleges were located at Wainsborough, Ninety-Six, and Charleston. The college at Ninety-Six College of Cambridge did not flourish. In 1792 the trustees were authorized to hold a lottery for its benefit, and in 1803 the property

<sup>2</sup> *Statutes at Large*, II, 276. *Ramsey*, II, 198. *Ramage, Local Government and Free Schools in South Carolina*, Johns Hopkins University Studies, Vol. I.

<sup>3</sup> *Statutes at Large*, II, 377.

<sup>4</sup> *Id.*, IV, 24.

<sup>5</sup> *Id.*, 174.

<sup>6</sup> *Acts of Assembly* (Columbia, 1808), I, 258.

was sold for debt.<sup>1</sup> Better success attended the College of Charleston. The act of 1785 vested in it the land before given for a free school in that city. In 1823 the college received a considerable grant of escheated lands,<sup>2</sup> and in 1854 it was given four thousand dollars in money. The college is still in existence.<sup>3</sup>

In 1795 all confiscated property in the district of Beaufort and all the vacant grants in the town of Beaufort were granted to a college to be established there.<sup>4</sup> "All the seminaries of learning . . . in the interior part of this State, being, for some fatal cause, become extinct," a college was established at Alexandria in 1797,<sup>5</sup> and two years later it was granted certain escheats.<sup>6</sup>

These it is believed comprise all the instances of public aid to the colleges of the early period.

## SOUTH CAROLINA COLLEGE.

The policy of multiplying institutions of limited means failed to meet the educational needs of the State. Governor Drayton drew attention to this fact in 1801 in his message to the Legislature, and urged upon that body the foundation of a State College, established and fostered by the Legislature and under its direct control.<sup>7</sup> The suggestion was favorably received, and the same year the South Carolina College was incorporated. Fifty thousand dollars were appropriated to erect buildings and six thousand dollars yearly for the support of the college.<sup>8</sup> The college was opened in 1805. From its establishment until 1863, when it was closed on account of the War, yearly appropriations, amounting in the aggregate to \$1,248,797,<sup>9</sup> were made to the institution by the State. During much of this time the State supported from one to three students at the college.

In 1865 the college was revived as the University of South Carolina.<sup>10</sup> Since that time the State has given the university in yearly appropriations \$199,911.28. From 1873 to 1876, the period when the institution was open to colored students, \$44,200 additional were given in scholarships. In 1877 the university was closed, and for the next four years the only appropriations made were for keeping the buildings in order. In 1881 the university was re-opened, with separate colleges for the

<sup>1</sup> La Borde, 6.

<sup>2</sup> Statutes at Large, VI, 211.

<sup>3</sup> A short account of the institution is given in "South Carolina; Resources, etc." (Charleston, 1883), pp. 490 ff.

<sup>4</sup> Acts of Assembly, II, 65.

<sup>5</sup> *Ibid.*, 155.

<sup>6</sup> Statutes at Large, V, 264.

<sup>7</sup> La Borde, 8.

<sup>8</sup> Acts of Assembly, II, 106. The act of incorporation is given in full in La Borde, II.

<sup>9</sup> Definite appropriations for insurance do not appear before 1828, although it was ordered that the buildings should be insured in 1819.

<sup>10</sup> Statutes at Large, XIII, 297. La Borde, 506, 573.



white and colored students.<sup>1</sup> The total amount of money appropriated by the State down to 1887, exclusive of scholarships, was \$1,748,708.28. The institution does not seem to have gotten all of this, as President McBryde says that from 1801 to 1888 \$1,446,481 were received from annual appropriations.<sup>2</sup>

#### STATE MEDICAL COLLEGE.

The medical college of South Carolina at its foundation in 1825 received from the State ten thousand dollars for buildings and apparatus. In 1853 it received a further grant of twenty thousand dollars.

#### THE MILITARY ACADEMY.

In 1812 the Legislature voted eight thousand dollars for a military school at the Arsenal at Columbia, and sixteen thousand dollars for a military school at the Citadel in Charleston, in lieu of the like sums before appropriated for the Arsenal and Magazine Guard at Columbia and the Citadel and Magazine Guard in Charleston.<sup>3</sup> This was the origin of the South Carolina Military Academy. In 1845, on the failure of an attempt to unite them, the Arsenal became auxiliary to the Citadel, providing for the instruction of the entering class.<sup>4</sup> In 1861 it was enacted that the two academies should together form the South Carolina Military Institute, still retaining their distinctive titles.<sup>5</sup> They continued on this basis until 1864, when they were closed. In 1882 the South Carolina Military Academy was opened at Charleston as a branch of the State university, and granted a yearly appropriation on condition that it should educate and maintain, free of charge, a certain number of cadets.<sup>6</sup>

During every year of its activity the institution has received money from the State. Down to and including 1864, the appropriations amounted to \$916,021.57, and since 1881 \$128,270.50 has been granted, making a total of \$1,044,292.07. In addition, beneficiary cadets were supported by the State for several years. The training has been by no means purely military; good literary and scientific instruction has also been given. The appropriations should not be regarded as entirely for educational purposes.

#### THE AGRICULTURAL COLLEGE.

The Constitution of 1868, after declaring that "the General Assembly shall provide for the maintenance of the State university," goes on to direct that provision be made, as soon as practicable, for the establishment

<sup>1</sup> *Annals of South Carolina*, 187.

<sup>2</sup> *Annals of South Carolina*, 28, 1887.

<sup>3</sup> *Statutes at Large*, VI, 280.

<sup>4</sup> *Id.*, XI, 114.

<sup>5</sup> *Annals of South Carolina*, 592.

<sup>6</sup> *Statutes at Large*, XII, 744.

<sup>7</sup> *Acts of Assembly*, 727.

<sup>8</sup> Appropriations were very much increased during the War, reaching \$117,200 in 1864.

of an agricultural college, and that the land appropriated by Congress for the latter purpose, be taken charge of.<sup>1</sup> Accordingly, the Legislature accepted the donation the same year, and ordered that the proceeds of the land sales should be invested in United States bonds or South Carolina six per cents.<sup>2</sup>

In 1872 the Agricultural and Mechanical College was established at Orangeburg in connection with the Claflin University. It was to be supported on the interest of the proceeds of the land sales.<sup>3</sup> Its income decreased from \$11,508 in 1872 to \$7,500 in 1876. In 1879 it was enacted that "the State Treasurer should issue to the trustees of the University of South Carolina a certificate of State stock in the sum of \$191,800, bearing interest at six per cent., \* \* \* to be held instead of the Agricultural College bonds, \* \* \* heretofore used by the financial agent for general State purposes."<sup>4</sup> Provision was made at the same time for a college for white students, in addition to the one for colored students, to be established and maintained out of the same fund. As far as necessary the grounds and property of the University of South Carolina were to be used for the new college, which was established in 1880.<sup>5</sup> Up to 1881, when the appropriations became confused with those for the State university, the Agricultural College had received from the permanent fund \$65,516.<sup>6</sup> The interest for the succeeding seven years would amount to \$80,556.

#### EXEMPTION FROM TAXATION.

The Constitution of 1868 exempts from taxation all buildings and premises actually occupied by colleges and institutions of learning.<sup>7</sup>

#### SUMMARY OF GRANTS.

We thus find the idea of State aid running through all the educational history of South Carolina, from 1710 to the present time. The policy has been generally that of annual appropriations. Frequent instances of public assistance occur among the colonial free schools and the colleges of the early period, while the Military Academy has received regular appropriations. But since the foundation of South Carolina College, the education of the State has had its center there, and there the State has been most liberal in its support.

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<sup>1</sup> Art. X, sec. 9; Poore's Charters and Constitutions, 1661.

<sup>2</sup> Statutes at Large, XIV, 163.

<sup>3</sup> Acts of Assembly, 172.

<sup>4</sup> *Ibid.*, 86.

<sup>5</sup> Resources, etc., of South Carolina, 482.

<sup>6</sup> No appropriation is given for 1873-74.

<sup>7</sup> Art. IX, sec. 5; Poore's Charters and Constitution, 1659.

## 204 FEDERAL AND STATE AID TO HIGHER EDUCATION.

### APPROPRIATIONS FOR 1887-88.<sup>1</sup>

|                                      |                |
|--------------------------------------|----------------|
| South Carolina College.....          | \$37,000       |
| South Carolina Military Academy..... | 20,400         |
| Charter University.....              | 5,000          |
|                                      | <hr/> \$62,400 |

The appropriations of State money may be thus summarized :

|                                      |                      |
|--------------------------------------|----------------------|
| South Carolina College.....          | \$1,748,708.28       |
| South Carolina Military Academy..... | 1,044,201.07         |
| South Carolina Medical College.....  | 30,000.00            |
| College of Charleston.....           | 4,000.00             |
|                                      | <hr/> \$2,822,909.35 |

### GEORGIA.

#### EARLY EDUCATION.

The earliest evidence of the attitude of Georgia toward education, as shown in her laws, is found in the Constitution of 1777, which directs that "schools shall be erected in each county, and supported at the general expense of the State."<sup>2</sup> Six years later one thousand acres of land were given to each county for the support of schools,<sup>3</sup> and an academy was established at Augusta, and endowed with public land, not to exceed two thousand acres.<sup>4</sup> These were the first steps in State education.

#### UNIVERSITY OF GEORGIA.

The University of Georgia traces its origin to an act of 1784, laying out the counties of Franklin and Washington, by which forty thousand acres of land were reserved for the endowment of a college.<sup>5</sup> In the following year the university was chartered.<sup>6</sup> In 1801 it received a private donation of six hundred and thirty acres of land near what is now the city of Athens, and there, soon afterward, it opened its doors.<sup>7</sup>

It was at first thought best to lease the lands of the university and apply the rent to its support; but, as this proved unprofitable, the lands were sold, payment being secured by bond and mortgage. These bonds and mortgages were deposited in the State treasury, and a warrant issued for two thirds of the amount they covered. As the State did

<sup>1</sup> Report of the U. S. Commissioner of Education, July 20, 1888.

<sup>2</sup> See *Constitution of Georgia*, 1777, Chapter I, § 2, 3. Circular of Information No. 4, 1887, p. 10.

<sup>3</sup> *Constitution of Georgia*, 1779, Chapter I, § 2.

<sup>4</sup> *Constitution of Georgia*, 1779, Chapter I, § 2.

<sup>5</sup> *Constitution of Georgia*, 1784, Chapter I, § 2.

<sup>6</sup> *Constitution of Georgia*, 1784, Chapter I, § 2.

<sup>7</sup> *Constitution of Georgia*, 1784, Chapter I, § 2.

<sup>8</sup> *Constitution of Georgia*, 1784, Chapter I, § 2.

not redeem this warrant it was regarded as a permanent debt, and eight per cent. interest on it was paid to the university.

This was the origin of the annuity of eight thousand dollars which the university has regularly received since 1815.<sup>1</sup>

Other benefactions have from time to time been received. Loans by the State to the amount of twenty-five thousand dollars have been made, and various minor appropriations amount to seven thousand five hundred dollars. Permission was given in 1806 to raise three thousand dollars by a lottery.<sup>2</sup> In 1830 one of the college buildings was destroyed by fire, and to replace this, six thousand dollars were annually appropriated until 1841.<sup>3</sup> In 1885 sixty-five thousand dollars were granted to establish a technological school in connection with the university.<sup>4</sup>

The donations of money made by the State since 1815 form a total of \$722,500.

#### GEORGIA MILITARY INSTITUTE.

The Georgia Military Institute was established in 1851 at Marietta.<sup>5</sup>

By the terms of the charter its property was exempt from taxation. The State set aside two thousand dollars annually for the support and education of not more than ten cadets,<sup>6</sup> and at least \$29,681.87 was appropriated in money in the period before 1865. The institute disappears toward the close of the War, and in 1870 its lands were granted to the Marietta Male Academy.<sup>7</sup>

#### MEDICAL COLLEGES.

At its foundation in 1833, the Medical College of Georgia received from the State ten thousand dollars in money and thirty lots in Augusta,<sup>8</sup> and the aid subsequently received is estimated at thirty-five thousand dollars.<sup>9</sup> In 1873 it became the medical department of the State university.<sup>10</sup>

The Southern Botanico-Medical College has received ten thousand dollars from the State,<sup>11</sup> and the Atlanta Medical College fifteen thousand dollars.<sup>12</sup>

<sup>1</sup> Stevens, 2. Laws of 1815, 103. Cobb's Digest, 1088.

<sup>2</sup> Laws of 1806, 9.

<sup>3</sup> Laws of 1830, 4.

<sup>4</sup> Laws of 1884-85, 69.

<sup>5</sup> Laws of 1851-52, 278.

<sup>6</sup> *Ibid.*, 6. Additional cadets were supported in 1860 and 1861.

<sup>7</sup> Laws of 1870, 455.

<sup>8</sup> Laws of 1833, 130. Cobb's Digest, 822.

<sup>9</sup> White: Statistics of Georgia, 81. Laws of 1860, 66.

<sup>10</sup> Centennial Catalogue of University, 5.

<sup>11</sup> Laws of 1871-72, 300. Laws of 1885-86, 279.

<sup>12</sup> Laws of 1887, 22.

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|                                      |                |
|--------------------------------------|----------------|
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| South Carolina Military Academy..... | 30,400         |
| Clavin University.....               | 5,000          |
|                                      | <hr/> \$72,400 |

The appropriations of State money may be thus summarized :

|                                      |                      |
|--------------------------------------|----------------------|
| South Carolina College.....          | \$1,748,708.38       |
| South Carolina Military Academy..... | 1,044,291.07         |
| South Carolina Medical College.....  | 30,000.00            |
| College of Charleston.....           | 4,000.00             |
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<sup>1</sup> Report of J. H. Keen, State Superintendent of Education, July 29, 1897.

<sup>2</sup> See *Constitution of Georgia*, by Charles Edgeworth Jones. (Circular of Information No. 4, 1895.) Department of Education.

<sup>3</sup> *Constitution of Georgia*, art. 1, § 3, par. 1.

<sup>4</sup> *Constitution of Georgia*, art. 1, § 3, par. 2.

<sup>5</sup> *Constitution of Georgia*, art. 1, § 3, par. 3.

<sup>6</sup> *Constitution of Georgia*, art. 1, § 3, par. 4.

<sup>7</sup> *Id.*

<sup>8</sup> *Constitution of Georgia*, art. 1, § 3, par. 5.

not redeem this warrant it was regarded as a permanent debt, and eight per cent. interest on it was paid to the university.

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#### GEORGIA MILITARY INSTITUTE.

The Georgia Military Institute was established in 1851 at Marietta.<sup>5</sup>

By the terms of the charter its property was exempt from taxation. The State set aside two thousand dollars annually for the support and education of not more than ten cadets,<sup>6</sup> and at least \$29,681.87 was appropriated in money in the period before 1865. The institute disappears toward the close of the War, and in 1870 its lands were granted to the Marietta Male Academy.<sup>7</sup>

#### MEDICAL COLLEGES.

At its foundation in 1833, the Medical College of Georgia received from the State ten thousand dollars in money and thirty lots in Augusta,<sup>8</sup> and the aid subsequently received is estimated at thirty-five thousand dollars.<sup>9</sup> In 1873 it became the medical department of the State university.<sup>10</sup>

The Southern Botanic-Medical College has received ten thousand dollars from the State,<sup>11</sup> and the Atlanta Medical College fifteen thousand dollars.<sup>12</sup>

<sup>1</sup> Stevens, 2. Laws of 1815, 103. Cobb's Digest, 1088.

<sup>2</sup> Laws of 1806, 9.

<sup>3</sup> Laws of 1830, 4.

<sup>4</sup> Laws of 1884-85, 69.

<sup>5</sup> Laws of 1851-52, 298.

<sup>6</sup> *Ibid.*, 6. Additional cadets were supported in 1860 and 1861.

<sup>7</sup> Laws of 1870, 455.

<sup>8</sup> Laws of 1833, 130. Cobb's Digest, 322.

<sup>9</sup> White's Statistics of Georgia, 41. Laws of 1860, 66.

<sup>10</sup> Centennial Catalogue of University, 5.

<sup>11</sup> Laws of 1874-75, 300. Laws of 1885-86, 279.

<sup>12</sup> Laws of 1877, 22.

Each of these colleges was in return to educate a certain number of students free.

#### ATLANTA UNIVERSITY.

This institution, founded in 1869 for the education of the blacks, has had since 1874 an annual appropriation of eight thousand dollars from the State. Eight thousand dollars was also granted in 1870. This appropriation is now suspended until such time as the institution shall cease to educate white students.

#### THE AGRICULTURAL COLLEGE FUND.

The share of Georgia in the land granted for agricultural colleges was two hundred and seventy thousand acres. The donation was accepted in 1866,<sup>1</sup> but it was not till 1872 that the Georgia State College of Agriculture and the Mechanic Arts was established at Athens. It is "a distinct organization, complete in all its parts, but still being an integral part of the University of Georgia."<sup>2</sup> It received fifteen thousand dollars from the State in 1875.<sup>3</sup>

Another college was founded in the same year, the North Georgia Agricultural College, at Dahlonega. Two thousand dollars of the annual income from the sales of land were set apart for its support, and twenty four thousand five hundred dollars additional has since been appropriated.

In 1874 the citizens of Milledgeville subscribed two thousand dollars annually to the payment of teachers in a college to be established in that town,<sup>4</sup> and in 1879 the State chartered Middle Georgia Agricultural College there.<sup>5</sup> This college gets annually \$1,500 from the land-scrip fund and \$1,000 from the rental of the State buildings at Milledgeville. Additional appropriations have also been received to the amount of \$8,500.<sup>6</sup>

Other agricultural colleges have been established at Cuthbert, Thomasville, and Hamilton,<sup>7</sup> all partly supported from the land-scrip fund. This fund was, in 1876, \$243,000.

All the above colleges are considered as branches of the State University. They have received assistance from the State to the amount of \$7,000.

#### EXEMPTION FROM TAXATION.

The act of 1850 exemption from taxation, hitherto confined to the University of Georgia, was extended to all other colleges.<sup>8</sup>

<sup>1</sup> Laws of 1866, 20, 21.

<sup>2</sup> Georgia College of University, 4.

<sup>3</sup> Laws of 1875, 11.

<sup>4</sup> Report of Trustees of University, 19.

<sup>5</sup> Laws of 1879, 20, 21.

<sup>6</sup> Letter from the Secretary, D. H. Hill, Jr., December 2, 1888.

<sup>7</sup> Laws of 1878, 7, 8; Laws of 1880, 31, 32.

<sup>8</sup> See also Hill, A. J. *Education*, Austin, Tex., 1877.

<sup>9</sup> *Cuba's Digest*, 1876, Part, I, 3, note; Laws of 1849-50, 379.

## CONSTITUTIONAL PROVISIONS.

Besides the article in the Constitution of 1777, already referred to, we find in that of 1798<sup>1</sup> the following :

"The arts and sciences shall be promoted in one or more seminaries of learning ; and the Legislature shall, as soon as conveniently may be, give such further donations and privileges to those already established as may be necessary to secure the objects of their institution ; and it shall be the duty of the General Assembly, at their next session, to provide effectual measures for the improvement and permanent security of the funds and endowments of such institutions."

The Constitution of 1865<sup>2</sup> reads thus :

"The General Assembly shall have power to appropriate money for the promotion of learning and science, and to provide for the education of the people ; and shall provide for the early resumption of the regular exercises of the University of Georgia, by the adequate endowment of the same."

## SUMMARY.

Georgia has pursued a consistent policy of State aid to higher education. Institutions for literary, scientific, professional, military, industrial, and technical education have received frequent assistance from the State. The policy of utilizing the public domain for the endowment of higher institutions of learning, put into legislative form by Georgia in 1784, marks a departure in the history of American State education, and for this Georgia deserves much credit.

The direct assistance of the State, exclusive of land endowments and scholarships, may thus be summarized:

|                                    |              |
|------------------------------------|--------------|
| State University, since 1815.....  | \$722,500.00 |
| Military Institute, at least ..... | 29,641.87    |
| Medical colleges .....             | 70,000.00    |
| Atlanta University, at least ..... | 104,000.00   |
| Agricultural colleges.....         | 57,000.00    |
| Total.....                         | \$943,141.87 |

FLORIDA.<sup>3</sup>

## THE SEMINARY GRANT.

Liberal provision for higher education in Florida was made by the United States. Two townships of land were granted in 1823,<sup>4</sup> and in the act admitting the State to the Union there were set apart "two en-

<sup>1</sup>Art. IV, sec. 13; Poore, 336. Report of the Commissioner of Education for 1867, 100.

<sup>2</sup>Art. II, sec. 5, 3; Poore, 406.

<sup>3</sup>See Education in Florida, George Gary Bush. (Circular of Information No. 7, 1894, Bureau of Education.)

<sup>4</sup>U. S. Statutes at Large, III, 756.



tire townships in addition to the two townships already reserved, for the use of two seminaries of learning, one to be located east and the other west of the Suwanee River.<sup>1</sup> The duty of selecting and securing these lands was by an act of 1835 intrusted to the register of the land office.<sup>2</sup> Eight years later five trustees were appointed to take charge of and lease the seminary lands. All sums that had been or should be obtained from this source were to be loaned on bond and mortgage at eight per cent.<sup>3</sup> In 1847 the register of public lands was given power to rent or sell the lands, and invest the proceeds in United States stock.<sup>4</sup>

The first move toward realizing the object of the grant was made in 1846, when a board composed of two persons from each section of the State was directed to give its views in regard to establishing the two universities.<sup>5</sup> An act of January 24, 1851, authorized the establishment of two seminaries of learning; the one east of the Suwanee was to be a normal school; the one on the west was to give instruction in the mechanic arts, in husbandry and agricultural chemistry, in the fundamental laws, and in what regards the rights and duties of citizens. As soon as the buildings of either seminary were ready for use, one-half of the interest on the seminary fund was to be passed to its credit.<sup>6</sup>

It is interesting to note that on the day the above act was passed a memorial of the Legislature to Congress requested that permission be given the State to appropriate the proceeds of the seminary lands to common schools.<sup>7</sup> A similar petition appeared in 1877, on the ground that it would be better to maintain efficient common schools and a normal school.<sup>8</sup> Both efforts seem to have been unsuccessful.

Liberal aid being granted by the inhabitants of the two towns, East Florida Seminary was located at Ocala (but afterwards removed to Gainesville) and West Florida Seminary at Tallahassee.<sup>9</sup> In 1869 they were made free schools, with the exception of the classical department of East Florida Seminary.<sup>10</sup>

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<sup>1</sup> Act of March 3, 1845.

<sup>2</sup> The Territory had assisted education by means of lotteries. Quincy Academy had been authorized to raise one thousand two hundred dollars by a lottery, while a like device was to secure ten thousand dollars for establishing and maintaining free schools at St. Augustine. See Laws of 1834, 56, 64.

<sup>3</sup> Laws of 1843, 26. (See also Report of the Commissioner of Education for 1876, 61 et seq. where the whole history of the seminary lands can be followed.)

<sup>4</sup> Laws of 1846-47, 47.

<sup>5</sup> *Ibid.*, 83.

<sup>6</sup> Laws of 1851, 51, 57.

<sup>7</sup> *Ibid.*, 139.

<sup>8</sup> Laws of 1877, 139.

<sup>9</sup> Laws of 1852-53, 84; Laws of 1856-57, 28; Laws of 1858-59, 50.

<sup>10</sup> Report of the Commissioner of Education for 1876, 63.

## STATE AGRICULTURAL COLLEGE.

The proceeds of the sale of land scrip, invested in United States or State bonds, were by an act of 1870 to form the endowment of Florida Agricultural College.<sup>1</sup> Its site was fixed at Eau Gallie, but as this was "a remote and comparatively unsettled and inaccessible part of the State," the Legislature in 1877 ordered that the college should be removed to any central point the trustees should select.<sup>2</sup> Lake City was chosen, and the college was organized in 1885. Up to 1887 \$30,750 had been received from the State.<sup>3</sup>

## CONSTITUTIONAL PROVISIONS.

Article X of the Constitution of 1838 reads as follows:

"SECTION 1. The proceeds of all lands that have been, or may hereafter be, granted by the United States for the use of schools and a seminary or seminaries of learning, shall be and remain a perpetual fund, the interest of which, \* \* \* shall be inviolably appropriated to the use of schools and seminaries of learning, respectively, and to no other purpose.

"SECTION 2. The General Assembly shall take such measures as may be necessary to preserve from waste or damage all land so granted and appropriated to the purpose of education."<sup>4</sup>

The substance of these provisions reappears in the Constitution of 1865.

The Constitution of 1868 contains the following provision:

"The Legislature shall provide a uniform system of common schools, and a university, and shall provide for the liberal maintenance of the same. Instruction in them shall be free."<sup>5</sup>

Educational property may be exempted by law from taxation.<sup>6</sup>

## SUMMARY.

Although Florida's educational policy has been one of State aid, her conduct is more creditable in the field of common schools than in the field of higher education, where it is only of late years that much activity has been manifested. The appropriations for the latter purpose, so far as ascertained, amount to \$30,750, for the Agricultural College.

<sup>1</sup> Laws of 1870, 45.

<sup>2</sup> Laws of 1877, 103.

<sup>3</sup> Report of Commissioner of Education for 1886-87, 710.

<sup>4</sup> Poore: Charters and constitutions, 326. Report of the Commissioner of Education for 1867-68, 112.

<sup>5</sup> Art. IX, sec. 2, Rep. Com'n Educ., 1867-68, 127; Poore, 355. In 1839 an act was passed in conformity to this provision. It was made the duty of the Board of Education "to use the available income and appropriations to the university or seminary fund in establishing one or more departments in the University," beginning with normal and preparatory work, but keeping in view the establishment of a university on a broad and liberal basis. See Laws, second session of 1839, 2, and further, Bush, Education in Florida, 4, 17.

<sup>6</sup> Art. XIII, sec. 1; Poore, 357.

The following extract taken from a letter received from Mr. Albert J. Russell, State Superintendent of Public Instruction in Florida, dated July 27, 1888, indicates the work being done by that State toward higher education. It indicates that Florida is assisting State institutions.

"There is no published statement of appropriations, except what is given in the journals of the various Legislatures. An annual appropriation of eight thousand dollars is made for normal colleges, and one of five thousand dollars for the Deaf-Mute Institute. These are fixed. Each Legislature, however, is frequently called upon for appropriations for the State college and State seminary. In 1885 ten thousand dollars were given to the State college, and in 1887 seven thousand five hundred dollars more to the same college and ten thousand dollars to the East Florida Seminary. Each of these institutions has a permanent inviolable invested fund of its own, the former one hundred and ninety-five thousand dollars, and the latter ninety-five thousand dollars, with sixty thousand acres of land unsold and in the market. The State also appropriates annually one thousand five hundred dollars for teachers' institutes. I believe these facts cover the field of our appropriations."

## CHAPTER VI.

### STATE EDUCATION IN THE NORTH-WEST TERRITORY.

The Ordinance of 1787 was the *magna charta* of the North-West Territory, wrested from Congress by the people. Though generally attributed to the generosity and wisdom of a central legislative body, the real spirit of its origin must be sought in the desires of the people who proposed to live in that Territory. It was the privilege of self-government, determined by the people, and granted by the supreme legislative body.

The Ordinance was not a cunning device wrought upon the theory of the abstract fitness of things. It arose from practical conditions, although its significance soon outstripped the most sanguine dreams of its originators. The design of Jefferson for universal freedom became enlarged, and was carried out by those directly interested in the settlement of the territory in question, and their faithful allies. The people demanded provisions for religion, for schools, and for the exclusion of slavery, and they were granted.

The far-reaching influence of the Ordinance was grasped by the mind of Webster, when he expressed his sentiments before Congress in the following words: "At the foundation of the constitution of these new north-western States, lies the celebrated Ordinance of 1787. We are accustomed, sir, to praise the law-givers of antiquity, and we help to perpetuate the fame of Solon and Lycurgus; but I doubt whether one single law, of any law-giver, ancient or modern, has produced effects of more distinct, marked, and lasting character than the Ordinance of 1787. That instrument was drawn by Nathan Dane, then and now a citizen of Massachusetts.<sup>1</sup> It was adopted, as I think I have

<sup>1</sup> The most recent criticism on the Ordinance of 1787 considers it the product of many minds, and not of an individual. "No one," says Mr. Poole, "I think, in the present state of investigation, can be regarded as its author. It came from a committee, and after action in two sessions of the committee is not known." The scribe of the committee was Nathan Dane, and if the manuscript of the final draft could be found, it would probably appear in his handwriting." See W. F. Poole, in Papers of American Historical Association, Vol. III, 6. The credit of framing the principal clauses is sometimes given to Dr. Matthias Cutler, the director of the Ohio Company. Although he is entitled to much credit, his associates—General Rufus Putnam, Samuel Haden Parsons, as well as the prominent members of Congress—a majority of them southern members, must be considered worthy sharers of the honor. It must be remembered, also, that prior work of Thomas Jefferson had already determined the plan of action.

understood, without the slightest alteration, and certainly it has happened to few men to be the author of a political measure of more large and enduring consequences."<sup>1</sup>

The importance of the Ordinance appears in the fact that the Federal Government acknowledged its right and duty to look after the educational interests of the people, and that, having placed the means of education within reach of the State governments, it threw all responsibility of organization and control of education upon the States. It placed in the care of the State a trust fund for the support of education and held the State responsible for the administration of the same.

Started as a policy in reference to a single State, the grants for education extended to all the States admitted thereafter, with the exception of those<sup>2</sup> whose land policies had been already settled at the time of their admission.

Though furnished the means of education, the settlers of "the Ohio" encountered many of the same difficulties of planting a university in the wilderness that were met by the colonists on the Atlantic seaboard. To force nature, on the one hand, by hard toil to yield her resources, and, on the other hand, to protect their homes from the ravages of the Indians and the jealousy of foreign nations, required nearly their entire attention, and left little time for culture.

But the desire for culture and learning was deep-seated and constant. The Ohio country was chiefly settled by persons from the New England and Middle States, who carried with them notions of education entertained by their fathers. Consequently we find an eagerness to found universities and colleges at the earliest opportunity. Two years after Ohio became a State, the Ohio University was chartered and organized, and five years thereafter the Miami University was located in Butler County. Ten years before the admission of Indiana the University of Vincennes was chartered and organized. Michigan and Wisconsin each chartered a university while they were yet Territories.

These universities were necessarily of slow growth, and in this respect they were not unlike other institutions of their own time. The growth of permanent institutions in new countries is always slow. Harvard is great with two hundred and fifty years to grace her venerable life, and Yale University will soon celebrate her one hundred and twentieth anniversary. If the Johns Hopkins University sprang within a decade to the foremost rank among the institutions of America, it was because the times were ripe for such an institution. More than two centuries of educational development prepared the way and made the support of the university possible.

Two principal motives characterize the haste to establish universities in the wilderness: the first was the zeal of the inhabitants for education, and the second the desire on the part of the people to secure to

<sup>1</sup> Webster's Works, III, 263.

<sup>2</sup> Maine, Vermont, Kentucky, West Virginia, and Texas.

their children the benefits of the Congressional grant. The principle was well illustrated that it takes something more than buildings and books and apparatus, and even professional teachers, to constitute a university. It takes the moral, intellectual, and material support of a community well advanced on the road to prosperity.

The management of the Congressional land grant for seminaries was an experiment, and almost a failure. The deplorably poor management of this public trust can not be entirely attributed to haste and inexperience, for Illinois, the last of the group to found a university, perhaps was the most unfortunate in the administration of the trust fund.

It is quite remarkable that, while Ohio has been trying to build three institutions endowed by the Federal Government, no less than thirty non-State universities and colleges have maintained a tolerably fair success, while some of these have rivalled in excellence the work of the State institutions. This might be urged as one of the circumstances preventing strong State institutions. If the best life forces of education are devoted to the upbuilding of local and denominational schools, a poorly managed State school-fund has small influence. Let it not be inferred that the writer has a desire to depreciate the work of non-State schools. Nothing can depreciate the work of these institutions. Through local pride and denominational zeal, through private benevolence and hard-grinding self-denial, multitudes of young men and women have been brought into the realm of culture, who otherwise would never have received the light, even with an Oxford or a Harvard in the State. The untiring zeal with which religious organizations have planted colleges and prospective universities in every valley of the West, as well as in every part of the South and East, is a spectacle for our wonder and admiration.

Scores of these institutions have succumbed to fate, while many others have had barely a nominal existence. Here, again, the zeal of propagandism and the appeal to local pride have called institutions prematurely into existence. Likewise the shifting tide of emigration and the powerful influences of railroads have left many a town with its embryo college by the wayside. With full recognition of all the merits of the multitude of schools that have been established, there has been a lack of centralization of power, of union of forces for utilizing in common the means of education. Where is there a fully equipped Methodist university, or a fully equipped Presbyterian or Baptist or Congregational university? Certainly not in America. There is a young State in the far West that contains among other institutions four colleges under the supervision of the Methodist Church. Each one of these colleges is ambitious to become a university. If three of them would be content to be colleges and allow the fourth to become a university, the latter might be a university in fact. But it will not be done, and thus educational forces are scattered.

In the North-West Territory, as in other parts of the United States,

schools under the patronage of the State have suffered not a little from the opposition of denominational schools, and this has tended to decentralize. It may be said, on the other hand, that State institutions have failed to recognize in some instances non-State schools or have treated them as rivals rather than as allies in a great cause. It is high time such folly and waste should be stopped by both sides.

The University of Michigan is the best example of the influence of a strong central institution in education. For years the youth from neighboring States have flocked to Ann Arbor as a Mecca of learning. Schools in other States, as well as in Michigan, have prepared students for the university. Taking the lead among the universities of the North West, the University of Michigan has had a powerful influence in shaping the educational policy of neighboring States, and a reflex influence has been felt in Illinois, Indiana, and Ohio. In fact, Michigan influence has been felt from Cornell to California University.

How long this influence will last, in view of the coming rivalry of Wisconsin, Kansas, Nebraska, Iowa, Illinois, and Indiana Universities, remains to be seen. If in the past the interference of the State in education has been at times a failure, the manner in which the States of the North-West are now developing their universities leads us to suppose that instances of poor administration are very rare. In the management of the seminary grants Michigan, though not without mistakes, has the best record, and Illinois the poorest of the group of the North-Western States, as the following investigation will show. While it is greatly to be deplored by the friends of education that the interests of the seminary fund were sacrificed in previous years, it is on the other hand highly gratifying to observe the tendency of the Legislatures to make good all losses, and as far as possible redeem the past.

#### OHIO.

The history of higher education in Ohio is of unusual interest, for the reason that it was the first State to struggle with the Congressional seminary land grant. Without experience and without precedent, the first Legislature began its early work of carrying out the educational policy inaugurated by the action of the Federal Government in the celebrated ordinance of 1787.

It is very remarkable that these first grants of land for seminaries of learning were made through contracts with companies the members of which were warm advocates of the measures, while the whole responsibility of controlling and utilizing the grants devolved upon the State Legislature; that these companies had a semblance of private institutions while the State was yet to be built; and that this reservation of land in the contract was for the benefit of the future State and has become a national policy in the building of every State since that time.

The results of education in Ohio are quite remarkable, when it is considered that, while the Legislature has attempted to foster and develop no less than three distinct universities, a multitude of sectarian and private institutions have sprung up, some to perish for want of nourishment, some to continue a miserable existence, and others to rise to a position of usefulness and independence. Out of this sporadic group of institutions, thirty-three colleges and universities yet remain, sufficient to constitute Ohio the banner State in respect to the number of its institutions for liberal culture.

## TREATMENT OF THE SEMINARY GRANTS.

The contract between the Ohio Company and the Federal Government embodied, among other things, that lot No. 16 in each township be given perpetually by Congress to the maintenance of schools, and lot No. 29 to the purposes of religion, and that two townships of good land near the center be also given for the support of a literary institution, to be applied to the intended object by the Legislature of the State.<sup>1</sup> In the same year John Cleves Symmes contracted with the Board of the Treasury for a large tract of land in the Territory in which reservations were made for schools and religion<sup>2</sup> similar to those in the grant to the Ohio Company, and one entire township was reserved for the support of a seminary of learning.

The former of these reservations led to the establishment of the State University of Ohio at Athens, and the latter to the founding of the Miami University. The selections of the first grant mentioned were made in 1795, in Athens and Alexander townships, by the Territorial Legislature. This body chartered in 1802, prior to the admission of Ohio as a State, the American Western University, at Athens, vesting the lands of the said townships in the corporation, and granting the trustees power to lease them for a period not to exceed twenty-one years.

The first Constitution of the State, adopted in 1802, assumes a liberal attitude toward education in general terms, but makes no specific provisions for the disposal of the seminary trust. It declares, nearly in the words of the compact of 1787, that "religion, morality, and knowledge being essentially necessary to the good government and the happiness of mankind, schools and the means of instruction shall be forever encouraged by legislative provision not inconsistent with the rights of conscience." Section twenty-five of the same article enacts that no law shall prevent the poor in different parts of the State from having full and "equal participation in the schools" endowed, "in whole or in part," from revenues arising from the Federal donation, and that "the doors of the said schools, academies, and universities shall be open for

<sup>1</sup> Bancroft, II. 133.

<sup>2</sup> These two grants were the only support ever given by Congress for the benefit of religion.

<sup>3</sup> Constitution of 1802, Art. VIII, sec. 3.



the reception of scholars, students, and teachers of every grade, without any distinction or preference whatever, contrary to the intent for which the said donations were made.

In connection with this idea of free State education, may be quoted section twenty-seven, which shows the catholicity of view then entertained by granting unrestricted privileges to charter private institutions. It reads as follows: "That every association of persons, when regularly formed within this State, and having given themselves a name, may on application to the Legislature, be entitled to receive letters of incorporation to enable them to hold estates, real and personal, for the support of their schools, academies, colleges, universities, and other purposes." In the amended Constitution of 1851, this section and the twenty-fifth, were omitted; the third section was essentially retained, while new provisions were made for the protection and preservation of school funds and the establishment of a common school system.

#### FOUNDING OF THE OHIO UNIVERSITY.

In the year 1801 the State Legislature repealed the law of 1802, and organized the "American Western University" under the name of the "Ohio University," and provided for its control by creating a board of trustees, twenty one in number, of which the Governor of the State and the president of the university, are ex-officio members and the remainder are nominated by the board with the approval of the General Assembly.<sup>1</sup> The two townships of land were placed in charge of this board of trustees as an endowment for a university, and explicit instructions were given pertaining to the disposal of the same.

The lands were to be subdivided into tracts of not less than eighty nor more than two hundred acres, to be valued by three disinterested freeholders, as in their original and unimproved state, and to be leased "for the term of ninety years, renewable forever, on a yearly rent of six per centum on the amount of their valuation, so made by said freeholders; and the land so leased shall be subject to a re-valuation at the expiration of thirty-five years, and to another re-valuation at the expiration of sixty years from the commencement of the term of each lease.

• • • Provided always that the corporation shall have the power to demand a farther yearly rent on the said lands and tenements not exceeding the amount of the tax imposed on property of like description by the State." Section seventeen exempts these lands with the buildings upon them from all State taxes forever. "This last provision was proffered to give to the university the State taxes upon those two townships, though the State did not undertake to collect them."<sup>2</sup>

<sup>1</sup> *Encyclopedia*, II, 193.

<sup>2</sup> *State Historical Societies of Education in Ohio*, 9.

<sup>3</sup> *Encyclopedia*, II, 193; *State Historical Societies of Education in Ohio*, 10.

<sup>4</sup> *Encyclopedia*, II, 217; *History and Management of Land Grants for Education in the North West Territory*, *Papers of American Historical Association*, Vol. I, No. 3, p. 119.

This policy seems to have been very fair and entirely liberal to the lessees; had it been adhered to, doubtless the institution in question would have been well-off to-day. As we look back over the history of the disposition of the educational land grants in the several States, it seems that there could have been no better policy than that of long leases with frequent re-valuations of the property. Twenty thousand acres were applied for in the following year and it appeared that all of the lands would soon be taken. But Governor Tiffin recommended in his message that a more liberal policy be pursued toward the lessees; consequently the law of 1804 was amended<sup>1</sup> so that the lands appraised in their original and uncultivated state could be leased for a term of ninety-nine years, with the privilege of renewal, at an annual rent of six per centum on the appraised valuation. However, lands were not to be leased on a valuation less than one dollar and seventy-five cents per acre.<sup>2</sup> These lands, with the exception of about two thousand acres sold in fee-simple, are still held by perpetual lease yielding but a scanty income based upon a valuation of eighty-four years standing. According to President Scott,<sup>3</sup> the rent from the forty-four thousand acres in 1883 was only twenty-four hundred dollars, while the aggregate assessed valuation of the university lands is \$1,060,000. The valuation of the act of 1805 for rental is only seventy thousand dollars; that is, had the first policy been adhered to, the university would now be receiving an income approximating \$63,600 in place of \$2,400.

A full discussion of the struggles of the university with the lessees and the Legislature is too long and complicated to be properly represented here, therefore only the conclusions will be given. When the law of 1804 was amended, in 1805, its meaning was not quite clear. This led to a contention as to whether the lands were subject to re-valuation. Consequently, in 1841, the trustees proceeded to re-value the lands, the thirty-five years specified in the first act having expired. The lessees objected, and the subject was argued before the supreme court of Ohio, which held that the lands were subject to re-valuation. The lessees appealed to the Legislature, and that body, strange as it may seem, practically set aside the decision of the supreme court in interpreting the meaning of the act of 1805.

Another similar misfortune is to be recorded, pertaining to the collection of the State taxes as an annual rent. The trustees, partly through neglect and partly through difficulty of collection, never received any rent in lieu of taxes until the year 1876. In 1841 they applied to the Legislature for assistance to enforce the collection, but without avail. Not until 1875 did the Legislature pass a law requiring the collection of the rents; since then the rents have been collected regularly, after having allowed the occupants to escape from taxation for seventy years. The yield of income from this source is about three thousand

<sup>1</sup> Laws of Ohio, III, 79.

<sup>2</sup> Knight, 120.

<sup>3</sup> *Ibid.*, 121.

dollars, making the total income to the university arising from two townships of land about seven thousand four hundred dollars per annum.

During recent years the Legislature has sought to do justice to the Ohio University, the oldest college of the State, by appropriations to supplement its small income. In 1881, twenty thousand dollars were voted for repairs on the buildings;<sup>1</sup> in 1883, ten thousand dollars<sup>2</sup> to assist in the completion of the building; and again, in 1885, four thousand nine hundred dollars for current expenses.<sup>3</sup> The university has received assistance at different times by appropriations from the Legislature amounting in all to about fifty-five thousand dollars.<sup>4</sup>

#### MIAMI UNIVERSITY.

The third seminary township granted to the State of Ohio in the contract of the Federal Government with John Cleves Symmes, was selected in Butler County, and is now known as Oxford. Immediately after this grant was confirmed by law,<sup>5</sup> in 1792, commissioners were appointed to locate the lands. After the location nothing was done toward the founding of a university until 1809, when the Miami University was chartered<sup>6</sup> and the seminary township granted to it as a permanent endowment. The terms for the disposal of the lands were exceedingly favorable to the new institution. They were divided into tracts containing not over one hundred and sixty acres, which were to be rented for ninety nine years to the highest bidder, provided that no lease should be based on a valuation of less than two dollars per acre. The lessees were to pay an annual rent of six per centum on the first bid, and the lands were to be subjected to re-valuation every fifteen years. But in the following year the Legislature repealed that portion of the former act requiring a re-valuation every fifteen years.<sup>7</sup> By this act of the Legislature gave a blow to the university from which it never recovered. Could a wise policy have prevailed instead of the short-sighted haste to build a university in the wilderness, Miami University would doubtless be a flourishing institution at the present time. The Legislature tried to aid the university, but the entire assistance given amounted to about thirty thousand dollars.<sup>8</sup>

The university was not opened until 1821, while the lands were all taken up as early as 1810. The valuation of the lands represents ninety-three thousand dollars, which yields an income of five thousand six hundred dollars. With this meager allowance the university continued its existence until 1873, when its doors were closed.

For many years past, for which the State was in a great measure responsible, the Legislature in 1885 appropriated twenty thousand dol-

<sup>1</sup> *Ibid.*, VIII, 95.

<sup>2</sup> *Ibid.*, VIII, 95.

<sup>3</sup> *Ibid.*, VIII, 95.

<sup>4</sup> *Journal of the Proceedings of W. H. Scott*,  
Columbus, 1888, p. 155.

<sup>5</sup> United States Statutes, I, 266.

<sup>6</sup> Laws of Ohio, VII, 1-4.

<sup>7</sup> *Ibid.*, VIII, 95.

<sup>8</sup> Letter from Pres. W. H. Scott, Columbus, July 31, 1888.

lars for repairs to the buildings of Miami University.<sup>1</sup> Other gifts have been made by the State. At present the university is in operation, having a productive fund of sixty-two thousand dollars, which yields an annual income of nine thousand five hundred dollars.<sup>2</sup>

It is generally conceded by all candid judgment on the subject that the management of the Ohio Seminary lands has been a failure, although the first plan for their management was well formed. It is not easy to explain the causes in a few words. Perhaps the haste to realize funds at once for carrying on the universities, the pressure brought to bear by the lessees and other interested parties, and the fact that the attention of the people was directed to the support of other institutions of learning, may be enumerated as the chief causes of the wild legislation and bad management of the funds.

## OHIO STATE UNIVERSITY.

Under the grant of 1862 Ohio received, in land scrip, six hundred and thirty thousand acres. By an act<sup>3</sup> of April, 1865, the Legislature authorized the sale of the land scrip at a minimum price of eighty cents per acre.<sup>4</sup> Subsequently the minimum price was fixed at fifty-three cents per acre. The lands were soon sold, and brought the sum of \$340,906.80, or an average of about ninety-four and one-half cents per acre. This amount was increased by interest on its investment until the opening of the college, in 1870, when it amounted to over four hundred thousand dollars, and in 1876 to five hundred thousand dollars.

In the year 1878 an act was passed by the Legislature reorganizing the university, under the name of the "Ohio State University."<sup>5</sup> It was located near Columbus, in Franklin County. The citizens of Columbus and of Franklin County gave three hundred thousand dollars for the erection of buildings. Another fund of about twenty-eight thousand dollars was contributed by the railroad companies and citizens combined.

Certain lands reserved by the compact of the United States and the Ohio Company, known as the Virginia military district, contained some remnants, which were donated to the State by the Federal Government in 1871. These lands in the following year were in turn donated by the State to the university at Columbus. They yielded upward of twenty thousand dollars. The funds of the institution have been constantly increasing. The last Report of the Commissioner of Education shows value of buildings, grounds, etc., to be eight hundred and fifty thousand dollars; the amount of productive funds to be \$537,841, and the income on productive funds to be \$32,270.

<sup>1</sup> Laws of Ohio, 1883, 193.

<sup>2</sup> Report of the Commissioner of Education, 1886-87, 701.

<sup>3</sup> Laws of Ohio, LXII, 189.

<sup>4</sup> *Ibid.*

<sup>5</sup> Revised Statutes of Ohio (1886), Vol. III, Supplement, Title 37, p. 765.

## 220 FEDERAL AND STATE AID TO HIGHER EDUCATION.

The State has been generous in its aid to the institution by making needed appropriations and otherwise encouraging the growing university. The following is a list of the appropriations granted since its organization:<sup>1</sup>

|           |            |            |              |
|-----------|------------|------------|--------------|
| 1876..... | \$5,150.00 | 1885.....  | \$25,500.00  |
| 1879..... | 15,800.00  | 1886.....  | 19,600.00    |
| 1880..... | 8,500.00   | 1887.....  | 19,400.00    |
| 1881..... | 1,350.00   | 1888.....  | 25,335.00    |
| 1882..... | 21,850.00  |            |              |
| 1883..... | 22,150.00  | Total..... | \$175,085.90 |
| 1884..... | 10,450.00  |            |              |

Other items swell the entire appropriation by the State to \$179,535.90.

### SUMMARY OF GRANTS.

|                                         |              |
|-----------------------------------------|--------------|
| Ohio University, at Athens.....         | \$55,000.00  |
| Miami University, at Chillicothe.....   | 30,000.00    |
| Ohio State University, at Columbus..... | 179,535.90   |
| Total.....                              | \$264,535.90 |

## INDIANA.

### TERRITORIAL EDUCATION.

The first Territorial Assembly of Indiana adopted measures for the establishment of a university. We have here one of the many instances on record of the attempts to place the "crown of the public school system" before the establishment of the system upon which it was to rest. However, it was not the intention of the early legislators to neglect the public common schools, seminaries and intermediate schools, as the sequel will show. It was to secure the Congressional seminary land grant and to obtain through the means of a university support to secondary and primary schools that a seminary of learning was to be planted in the wilderness. But it took over half a century to mature the plans of the early legislators.

The organization of the Indiana Territory took place in 1800, and four years thereafter Congress passed an act which provided among other things for the disposition of the public lands within the Territory. The act of Congress of 1804 divided the Territory into three land districts, viz, Kaskaskia, Detroit, and Vincennes, which later formed essentially the respective States of Illinois, Michigan, and Indiana.

The fifth section of the said act, after designating what land shall be reserved for public schools, states that there shall be set apart "an entire township in each of the three described tracts of country, or districts to be located by the Secretary of the Treasury for the use of a

<sup>1</sup>Letter from Pres. W. H. Scott, November 22, 1898.

seminary of learning."<sup>1</sup> It was not until October 10, 1806, that the township of land falling within Vincennes Territory was located, according to law, by Albert Gallatin, the Secretary of the Treasury.<sup>2</sup> The lands were chosen in Gibson County, and the university was located in the borough of Vincennes.

#### INCORPORATION OF VINCENNES UNIVERSITY.

The General Assembly at its first sitting (1806) passed an act incorporating the Vincennes University. A somewhat lengthy preamble sets forth the views of these early legislators on the importance of education.

The preamble commences as follows: "*Whereas*, The independence, happiness, and energy of every republic depends (under the influence of the destinies of Heaven) upon the wisdom, virtue, talents, and energy of its citizens and rulers; and *whereas*, science, literature, and the liberal arts contribute in an eminent degree to improve those qualities and acquirements."<sup>3</sup> Proceeding from this the article continues to advocate learning as the support of "liberty" and "rational" religion; and "philosophy, and literature" as the best means of furnishing "pleasant occupation;" and the diffusion of knowledge as "requisite for a magistrate and elector." Then follows the body of the act, establishing a university, under the control of a board of trustees, who were given power to make laws for its control in accordance with the laws of the Territory and of the United States. The trustees were to appoint a president of the university, and "not exceeding four professors, for the instruction of youth in Latin, Greek, French, and the English languages, mathematics, natural philosophy, logic, rhetoric, and the law of nature and of nations."

It was further enacted that the departments of theology, law, and physics might be established, and whenever the funds of the university permitted, all students were to be educated gratis in all or any of the branches they might require. "No particular tenets of religion" were to be taught in the university.

Among other things provided for in this act was the raising of funds, not exceeding two thousand dollars, by means of a lottery, "to be conducted by five discreet persons chosen by the trustees;" also, a clause was inserted providing for the teaching of the children of the Indians, who were to be instructed, clothed, and fed while in attendance.

It was further enacted "that the said trustees, as soon as in their opinion the funds of the said institution will admit, are hereby required to establish an institution for the education of females," etc.

Thus was established the first university in the new Territory, but it

<sup>1</sup>U. S. Statutes, II, 277.

<sup>2</sup>Woodburn's History of Higher Education in Indiana, MS. for circular of Information, Bureau of Education.

<sup>3</sup>Woodburn, MS.

was only established by law; it was not yet built. Time must first see the failure of the exalted plans of the founders, the doors of a struggling institution closed before a university could be developed.

It was not until the year 1810 that the university was formally opened for instruction, and then it was only allowed to teach the elementary branches until the university should gain strength. Even then the university must start with the private school of Rev. Samuel Scott as a nucleus.

In 1807 the trustees were legally authorized to sell a quantity of land, not exceeding four thousand acres, of the seminary township, and to rent the remainder "to the best advantages for the use of said university."<sup>1</sup> The trustees soon sold four thousand one hundred and thirty-six acres, and rented parts of the remainder. With the proceeds, about six thousand dollars, the first building was erected. Although the school was in existence from this date until 1825, neither the State nor Territory gave it aid. The trustees allowed their organization to become illegal through lack of attention, and the State withdrew its care.

In 1822 the State passed an act virtually confiscating the lands of the university, and devoted them to the support of the State seminary established at Bloomington. In consequence of this act the institution was suspended in the following year, and afterward re-opened under the name of the Knox County Institute.

In 1824 the Legislature declared that the Vincennes University "had expired through the negligence of its members."<sup>2</sup>

"This act of 1822 recited the fact that the trustees of the Vincennes University had sold portions of such lands, and had negligently permitted the corporation to die without having executed deeds to purchasers, and the act provided for the sale of the seminary township, in Cass County, and for the use of the money as a productive fund for the benefit of the State seminary previously established at Bloomington."

Proceeding upon the assumption that the lands granted to Vincennes University had belonged to the State, the Legislature passed acts in 1826 and 1827 which authorized the sale of the seminary townships in Cass and Monroe Counties.

It was further provided "that it shall be the duty of the Treasurer of the State to pay quarterly to the president of the board of trustees of the State seminary, to the order of said president, \* \* \* any interest of money in his hands, that may have heretofore accrued, or that hereafter may accrue, from the sales of the seminary townships above named. However, no greater sums should be paid in this manner than the amount of the yearly expenses for salaries in the seminary.

<sup>1</sup> Laws of 1807, chap. 100, p. 95.

<sup>2</sup> Laws of 1824, p. 38.

<sup>3</sup> Laws of 1826, p. 38.

<sup>4</sup> Laws of 1827, chap. 100, p. 95.

<sup>5</sup> The sections near the seminary were reserved.

<sup>6</sup> Laws of 1827, chap. 100, p. 98.

## LITIGATION BETWEEN THE VINCENNES UNIVERSITY AND THE STATE OF INDIANA.

In the year 1828 the Legislature authorized a loan of the seminary funds and the payment of the interest to Indiana College.<sup>1</sup>

From the above acts, under which seventeen thousand acres of Gibson County lands were sold and the proceeds placed to the credit of the State seminary fund, sprang the famous litigation between the trustees of Vincennes University and the State of Indiana. The history of this litigation is briefly stated in Woodburn's History of Higher Education in Indiana as follows :

" The withdrawal of State care and attention from this early school is not fully explained. The removal of the capital of the Territory, and consequently of public influence from Vincennes to Corydon, in 1813, the carelessness and suspension of its own board of trustees, and the indifference of its friends, the rise of similar 'academies' and 'seminaries' in other portions of the State, the desire to have the State seminary near the center of population, which was moving rapidly toward the north, and perhaps political influence—all these worked adversely to the continuance of the school at Vincennes as a State institution.

" But after the school had continued for some years as the Knox County Seminary, the old corporation was resuscitated by an act of the Legislature in 1838 making provision for supplying vacancies in the board of trustees. A clause, however, was inserted in this act intended to prevent the renewal of any claim to the seminary township taken from it in 1822. But in 1845 the trustees of Vincennes University, thus revived, laid claim to the Gibson County lands and to the proceeds of previous sales made by the State, which had been transferred to the Indiana University, formerly the State seminary, and suit was brought to test the question of title.

" In January, 1846, in order to make legal a suit against the State and to relieve the occupants of the lands of responsibility and litigation, an act was passed by the State Legislature authorizing the trustees of Vincennes University to bring suit against the State of Indiana for other purposes. This suit in the Marion County circuit court resulted in a decree in favor of the trustees in the amount of \$30,099.66.

" On an appeal to the supreme court of the State the decision was reversed, the court holding that the act of the Territorial Legislature of 1806 granting the lands of the Vincennes University was nugatory, because no such power was vested in it by act of Congress, and that they were not, at the time of sale and disposal, in existence as a corporation, having allowed their corporation to lapse.

" The trustees of Vincennes University were not satisfied with this decision, and they sued out a writ of error from the Supreme Court of the United States, which at the December term, 1852, reversed the decision.

<sup>1</sup> Laws of 1828, chap. 57, p. 127.



*and of the supreme court of the State, holding that when the Territorial Legislature of 1890 incorporated a board of trustees for the Vincennes University, a grant of a township in the Vincennes district by the Congress of 1804, and which was located by the Secretary of the Treasury in 1805, attached to this board, although for the two preceding years there had been no grantee in existence; and holding further that if the board of trustees, by a failure to elect when vacancies occurred or to elect by other means, became reduced to a less number than was authorized by the charter, the corporation was not thereby dissolved, but its franchises only suspended until restored by legislative action.*

The Vincennes University obtained judgment in its favor to the extent of \$100,000, but as one-fourth went for counsel fees<sup>1</sup> only about forty thousand dollars were realized.

#### CONSTITUTIONAL PROVISIONS.

The attitude of the State of Indiana toward the promotion of education and the establishment of a system of schools including all grades from the elementary to the university is plainly indicated in the first state Constitution, adopted in 1816. As in its Territorial organization, some of its legislators were ambitious for the advancement of learning. The state then provided for a system of education by a constitutional act, and the people voted for the same; but many years were to elapse before a respectable system of schools should be established. There was need of the schools, but the nascent state of the country would not admit of a tax on education. Even the beginnings of colleges and universities, started under whatsoever auspices, were feeble institutions at best.

Section one of Article IX of the Constitution of 1816 treats of the necessity of a general diffusion of "knowledge and learning" for the "preservation of a free government," enjoins upon the General Assembly the duty of protecting and improving the public lands granted for school purposes, and finally closes with the following clause: "The General Assembly shall, from time to time, pass such laws as shall be calculated to encourage intellectual, scientific, and agricultural improvement by allowing rewards and immunities for the promotion and improvement of arts, sciences, commerce, manufactures, and natural history, and to countenance and encourage the principles of humanity, industry, and morality."<sup>2</sup> This was followed by a more specific statement which enacts that, "It shall be the duty of the General Assembly, as soon as circumstances will permit, to provide by law for a general system of education, ascending in a regular gradation from township schools to a State university, wherein tuition shall be gratis

<sup>1</sup> The successful attorney at the counsel, Mr. Judah, for retaining an expensive Mr. English, afterwards secured a defeat in two lower courts, finally won the case in the Supreme Court of the United States.

<sup>2</sup> Constitution of Indiana, 1816, Art. IX, sec. 1.

and equally open to all."<sup>1</sup> It was further provided that, "For the promotion of such salutary ends, the money which shall be paid as an equivalent by persons exempt from militia duty, except in times of war, shall be exclusively and in equal proportions applied to the support of county seminaries; also all fines assessed for any breach of the penal laws shall be applied to said seminaries in the counties wherein they shall be assessed."<sup>2</sup>

#### THE NATURE OF THE SCHOOL SYSTEM.

Thus "the pioneer legislators of Indiana conceived an educational system that should meet the entire wants of the people. The common school was to be its base and the State university its apex. The county seminary was to fill the space between and furnish a preparatory course for the university. The conception was good in theory, but did not succeed well in practice. The failure was caused by a general want of successful educators at the head of the county seminaries who could draw support and build them up."<sup>3</sup>

But this plan has been approximated to after many years of partial success and failure. The undeveloped state of the country must be taken into account for the greater part of the failure. It is shown by the history of every State in the Union that where a territory is settled by individuals, and local interests have been first inaugurated, a complex school system can not exist until a comparatively highly developed state of society is reached.

Localism and sectionalism, which have brought into existence so many premature institutions, and have likewise caused their early death, have had their influence upon State systems of learning everywhere. Not until a new territory becomes sufficiently thickly settled, so that the interests of different sections touch each other and a common sentiment of justice flows, and a feeling of unity prevails throughout the State, will there be a successful system of education. Commonwealths grow into real being, and in nearly every case the first legislators anticipate the needs of a people by a long period of time.

The university was not organized for eighteen years after the adoption of the Constitution, although a seminary was soon started. There was provision in 1824 for the organization of county seminaries, while the common school system was not established until 1851, thirty-five years after the adoption of the Constitution, forty-seven after the Territorial organization, and one hundred and twenty-one after the settlement of the country (1730).

#### FOUNDING OF THE UNIVERSITY.

When Indiana was admitted to the Union in 1816, an additional township of land was granted to the State for the support of an institution

<sup>1</sup> Constitution of Indiana (1816), Art. IX, sec. 2.      <sup>2</sup> Smart: Schools of Indiana, 26.

<sup>3</sup> *Ibid.*, sec. 3.

of advanced learning. A provision in the Constitution required that no lands should be sold prior to 1820. In this year the State Seminary was incorporated,<sup>1</sup> and located at Bloomington, in Monroe County. This was the organic beginning of the present Indiana University. The seminary was endowed with the new township, and also with the Gibson County lands, hitherto referred to as granted to Vincennes University, with the exception of four thousand acres already sold.

#### TREATMENT OF PUBLIC LANDS.

The first plan was to derive an income for the new institution by lease of the lands,<sup>2</sup> but afterwards it was determined to sell the remainder of these lands, the minimum price being fixed at five dollars per acre.<sup>3</sup>

"This is the earliest instance," says Knight, "in the North-West Territory where the system of leasing university lands was formally abandoned in favor of the method since adopted by the five States."<sup>4</sup> But it seems that the Legislature returned to the old plan and leased the Monroe County lands at public auction by an act of 1825, the minimum rental being fixed at sixty-two and one-half cents per acre.<sup>5</sup> All the rents and accumulations of the fund of the Gibson County lands were appropriated at this time by the Legislature.

Two years later it was enacted that all the unsold lands should be divided into three classes, and the minimum prices be graded at three dollars and a half, two and a quarter, and one and a quarter, respectively.<sup>6</sup>

These lands, with the exception of three sections near the university, were to be sold at public auction within a year, and the proceeds placed in the State treasury, while the interest was placed under the control of the trustees. The fund was loaned in small amounts to private parties on not more than five years' time, at six per cent. per annum, instead, as had been the custom previously, of loaning to the State.<sup>7</sup>

In 1828 the three sections near Bloomington, previously reserved, were placed under the control of the trustees. Subsequently (1830) one section was sold,<sup>8</sup> at a minimum price of five dollars per acre, and finally the remaining two, to purchase apparatus for the college. The lands not sold at auction might be purchased privately at the minimum prices established in 1827. The minimum prices of the three grades of land above referred to were placed in 1830 at two dollars and a half, one and a half,

<sup>1</sup> Laws of Indiana, 1820, chap. 48, p. 32.

<sup>2</sup> *Ibid.*, p. 160.

<sup>3</sup> *Ibid.*, 1822, p. 111.

<sup>4</sup> Land Grants for Education in the North-West Territory.

<sup>5</sup> Laws of Indiana, 1825, p. 97; see Knight, 126.

<sup>6</sup> See Knight, 127.

<sup>7</sup> Laws of Indiana, 1828, p. 127.

<sup>8</sup> *Ibid.*, 1830, p. 103.

and seventy-five cents per acre, respectively.<sup>1</sup> At these low prices a greater proportion of the lands were soon sold, but the remainder was taken up slowly.

By 1843 forty-two thousand acres had been sold, which yielded an income of about five thousand dollars to the university, the fund itself amounting in 1846 to \$59,770, exclusive of balances still due from purchasers.<sup>2</sup>

After the case in litigation between the Vincennes University and the Indiana University was finally decided in the former's favor, the United States granted to the Indiana University an amount of land equivalent to the amount for which the Vincennes University had obtained judgment; and again, in 1852, the Federal Government granted 4,136 acres in lieu of the four thousand acres sold by the Vincennes University.<sup>3</sup> Thus more than a township of new lands accrued to the Indiana University, which were appraised in 1859 and sold at auction. From sixty thousand acres thus sold \$139,036.74 were realized, and composed the fund in 1882.<sup>4</sup> This was at an average of about two dollars and thirty cents per acre. At that date there were 8,526 acres still unsold.

#### INDIANA COLLEGE.

To place the seminary under more immediate control of the Legislature, a board of visitors was instituted and required to report annually to the General Assembly.<sup>5</sup>

In the following year (1828) the seminary<sup>6</sup> was changed into the Indiana College, which was placed under the control of fifteen trustees.<sup>7</sup> The college was established "for the education of youth in the American, learned, and foreign languages, the useful arts, science, and literature."<sup>8</sup> It was enacted that no sectarian principles were to be inculcated, and that instructors and students were not to be denied any rights and privileges on account of religious opinions. Immediately following this change, the vigorous and popular administration of Dr. Andrew Wylie took place. The old-time classical college curriculum was followed, which afterwards gave place to the "one study" system.<sup>9</sup>

#### INDIANA UNIVERSITY.

Again, in 1838, the Indiana College was enlarged, and became Indiana University,<sup>10</sup> which latter name it has retained to the present time.

<sup>1</sup> Laws of Indiana, 1839, p. 167.

<sup>2</sup> Auditor's Report, 1846; quoted by Knight, 127.

<sup>3</sup> Knight, 139; cites U. S. Statutes, X, 367.

<sup>4</sup> Auditor's Report, 1882.

<sup>5</sup> Woodburn, MS.; Laws of Indiana, 1827, chap. 101, p. 99.

<sup>6</sup> Smart, 138.

<sup>7</sup> Laws of Indiana, 1828, chap. 82, p. 115.

<sup>8</sup> Woodburn, MS.

<sup>9</sup> Smart, 138.

The powers, rights, and property of the trustees of Indiana College were vested in the trustees of Indiana University. The sciences of law and medicine were added to the course of study, and the university was placed under the control of twenty-one trustees.<sup>1</sup> The law school was organized in 1840 and continued until 1877, when it was abolished; a school of medicine was never established. The board of trustees was reduced to nine members in 1841.<sup>2</sup>

By laws passed in 1852 and 1855, respectively, the Governor of the State, the Lieutenant-Governor, Judges of the Supreme Court, Speaker of the House, and Superintendent of Public Instruction were made *ex officio* members of the board of trustees, consisting regularly of eight members.

From the time of the organization of the seminary through its changes into Indiana College and finally to Indiana University, even to the year 1867, the institution had been subject to State control, but had received no aid from the State treasury. It is true that a law was enacted by the Legislature in 1828 for the purpose of raising revenue by local taxation for the Gibson County Seminary. By this act fifty per cent. was levied "on the State and county revenue on all persons and property within the town of Princeton; twenty-five per cent. on all persons and property not within said town, but within a distance of two miles;"<sup>3</sup> twelve and one-half per cent. within a distance of two to four miles; and eight per cent. on persons and property within the county and not including the foregoing lists. It was a State institution in creation and control, but still a Federal institution in its support.

But a new era dawned upon the university at this time. By an act<sup>4</sup> of March 8, 1867, the Legislature, in order to supplement the meagre endowment of the university, made an annual appropriation of eight thousand dollars. Soon afterward eight thousand dollars additional was voted to meet the indebtedness of the institution.

In 1874 the annual endowment was increased by the sum of fifteen thousand dollars, making the permanent annual endowment twenty-thousand dollars.

The most notable advance in the legal history of the university, and the one which will do more than any other to result in the fulfilment of the aims of the founders of the institution, is found in the "Act to provide a fund for the permanent endowment of the Indiana University," approved March 8, 1883. By this act, the passage of which was secured largely by the efforts of the alumni, it was provided that "there shall be assessed and collected, as State revenues are assessed and collected, in the year 1883 and in each of the succeeding twelve years, the sum of one-half of one per cent. on each hundred dollars of taxable property in the State, which money when collected and paid into the

<sup>1</sup> Laws of Indiana, 1828, chap. 177.

<sup>2</sup> Laws of Indiana, 1828, chap. 83, p. 120.

<sup>3</sup> Laws of Indiana, 1828, chap. 177.

<sup>4</sup> Laws of Indiana, 1867, chap. vi, p. 29.

<sup>5</sup> Laws of Indiana, 1873, chap. x, p. 17.

State treasury in each of the years named in this act shall be placed to the credit of a fund known as the Permanent Endowment Fund of the Indiana University.<sup>1</sup> It is estimated that this tax will give a fund in twelve years of more than seven hundred thousand dollars.

#### SPECIAL APPROPRIATIONS.

Besides those already mentioned the Legislature of Indiana has made special appropriations to the university at Bloomington as follows: In 1873, for building purposes,<sup>2</sup> ten thousand dollars; in 1873, for contingent expenses,<sup>3</sup> twelve thousand dollars; in 1874, for building purposes, ten thousand dollars; in 1874, for contingent expenses, twelve thousand dollars. In 1885 the sum of thirty thousand dollars was granted for the purpose of erecting buildings destroyed by fire.<sup>4</sup> For the latter purpose two colleges were erected by Monroe County.

#### PURDUE UNIVERSITY.

This institution was first organized under the name of the Indiana Agricultural College, located at La Fayette, in accordance with the stipulations of the Congressional grant of 1862. Indiana's share of the grant was 390,000 acres in land scrip, which yielded a fund from sales of \$212,238.50; this had increased to the sum of \$265,000 in 1876, according to Mr. Smart,<sup>5</sup> and amounted in 1885 to \$340,000, yielding an annual income of \$17,000.<sup>6</sup>

Hon. John Purdue, a citizen of La Fayette, gave as an endowment to the college one hundred and fifty thousand dollars, and its name was subsequently changed to Purdue University. On condition that it should be located in Tippecanoe County said county gave to the University the sum of fifty thousand dollars. To carry out its part of the contract the State, by the General Assembly, devoted eighty thousand dollars for buildings and grounds.<sup>7</sup>

The total value of the funds, productive and unproductive, amounted to \$650,000 in 1883.<sup>8</sup>

The State has made the following special appropriations for its support:

|                             |                  |
|-----------------------------|------------------|
| 1873.—Improvements.....     | \$360,000        |
| 1875.—For two years.....    | 20,000           |
| 1877.—For two years.....    | 19,500           |
| 1879.—For two years.....    | 9,000            |
| 1881.—For two years.....    | 40,000           |
| 1885.—For four years.....   | 88,000           |
| 1885.—For improvements..... | 12,500           |
| <b>Total.....</b>           | <b>\$249,000</b> |

<sup>1</sup> Quoted in Woodburn's History of Higher Education in Indiana.

<sup>2</sup> Laws of Indiana, 1873, pp. 7, 9.

<sup>3</sup> *Ibid.*, 1875, chap. 32, p. 65.

<sup>4</sup> Schools of Indiana, 155.

<sup>5</sup> *Ibid.*

<sup>6</sup> State Report, 1882-83.

<sup>7</sup> *Ibid.*

<sup>8</sup> Laws of Indiana, 1873, chap. IV, p. 16.

<sup>9</sup> *Ibid.*, 1875, chap. X, p. 19.

<sup>10</sup> Letter from President J. H. Smart, January 14, 1879.

## COUNTY SEMINARIES.

The seminaries of Indiana would fall, according to modern classification, within the grade of secondary schools; but as a support and beginning of higher education in early times they deserve a passing notice. Elsewhere in this paper the constitutional provisions relative to the public school system have been cited as authorizing "seminaries" of learning in the several counties. This was followed by a law, approved in 1824, authorizing the establishment of seminaries in each county in the State. In the following year county seminaries and district schools began to be built by means of public revenue, supplemented by contributions of materials and labor levied as a tax on individuals.<sup>1</sup> The frequent incorporation of seminaries seemed to indicate that the system would be a success.

By an act of the Legislature passed in 1827 seminaries were incorporated in Wayne, Franklin, Henry, Rush, Randolph, Allen, Vigo, Daviess, Madison, Hamilton, and Sullivan Counties.<sup>2</sup> By subsequent acts of the same year a seminary was incorporated in each of the following counties, viz: Washington, Harrison, Knox, Fayette, and Clark.

Yet the system did not succeed, although by 1837 the General Assembly had incorporated twenty-six by special legislation, and many more under a general law.

However, in 1852, after the reorganization of the school system under its present form, the Legislature ordered the sale of all the property, real and personal, constituting the county seminaries, and the placing of the net proceeds to the credit of the common school fund.<sup>3</sup>

## THE COMMON SCHOOL FUND.

Although the system of public schools was not established until 1852, the permanent fund of the same has grown to enormous proportions, and has been derived principally from the following sources:

1. The sale of the township sixteenth sections granted for common schools, as in other States.

2. In 1834 a fund of eighty thousand dollars was derived from a tax of two and a half per cent. on each share of bank stock.

3. The Legislature provided by the same act that the State bank should be established, and authorized a loan of \$1,500,000; eight hundred thousand dollars of this was to pay for the stock in the bank, and five hundred thousand dollars to be loaned to individuals.<sup>4</sup> A sinking

<sup>1</sup> See *Journal of the General Assembly of the State of Indiana*, 1824, p. 17. The act of the early school taxes in Indiana was levied in the name of the county, and every owner in the district was obliged to furnish so many days work as would amount to the tax.

<sup>2</sup> See *Journal of the General Assembly of the State of Indiana*, 1827, chap. 46, pp. 87-89.

<sup>3</sup> See *Journal of the General Assembly of the State of Indiana*, 1852, chap. 46, pp. 87, 88, 89.

<sup>4</sup> See *ibid.*, p. 90.

<sup>5</sup> *Id.*, p. 90.

fund was established to pay the loan, including the expenses and the interest; the remainder of the loan was ordered to be turned into a permanent fund for the purpose of common school education. This has increased the common school fund about \$5,500,000.<sup>1</sup>

(4) The surplus revenue fund of 1836 was devoted to the cause of education, and yielded the sum of \$862,254 to Indiana's share; \$573,502.96 were set apart to augment the common school fund.

(5) The proceeds of the sales of swamp lands of the 1850 grant were devoted to the common school fund.

(6) All salt springs in Indiana Territory, granted to the Territory by act of Congress in 1816, were devoted to the school fund. From this source eighty-five thousand dollars were realized.

(7) Sales of the county seminary lands were returned to common school fund.

(8) The contingent fund, yielded from escheats, fines, etc.

The fund has continued to increase from time to time until it now amounts to nearly nine millions (\$8,799,191).<sup>2</sup> Nearly the entire fund was devoted to common schools.

## SUMMARY OF GRANTS.

*Indiana University, Bloomington.*

|                                                                                                                                   |             |
|-----------------------------------------------------------------------------------------------------------------------------------|-------------|
| Annual grant, 1867-73, \$3,000 .....                                                                                              | \$48,000    |
| Annual grant, 1873-80, \$23,000 .....                                                                                             | 374,000     |
| Special appropriation .....                                                                                                       | 82,000      |
| One-half of one per cent. tax on each \$100 of taxable property in the State for a term of twelve years, 1882-95, estimated ..... | 700,000     |
| Total .....                                                                                                                       | \$1,204,000 |

*Purdue University.*

|                                 |             |
|---------------------------------|-------------|
| Appropriations, 1874-1880 ..... | 243,000     |
| Total .....                     | \$1,453,000 |

## ILLINOIS.

No direct efforts were made by the State of Illinois to encourage higher education until the year 1867. The action taken then was in compliance with the conditions of the act of Congress donating public lands to the several States for the purpose of establishing colleges for the benefit of agriculture and the mechanic arts. The attitude of the State during the first fifty years of its existence was, on the whole, one of indifference to the interests of higher education. Not only did the State withhold the funds which the Federal Government appropriated

<sup>1</sup> Smart, 33.<sup>2</sup> *Ibid.*, 9.



for the establishment of a college and seminary of learning, but for a number of years made use of them for other purposes, thus in a sense antagonizing the interests of higher education.<sup>1</sup>

#### COLLEGE AND SEMINARY FUNDS.

In 1804 Congress, as we have seen in a previous chapter, established three land districts in the Territory of Indiana (Vincennes, Kaskaskia, and Detroit). In each of these land districts a certain section in every township was set apart for school purposes, and also one township in each land district for the use of a seminary of learning. In 1809 the Kaskaskia district became known as the Territory of Illinois, retaining the same rights and privileges as under the former government.<sup>2</sup> The act admitting Illinois into the Union in 1818 confirmed the appropriations made for the Territory, and in addition gave a second township for the support of a seminary of learning.<sup>3</sup> This additional appropriation of a township was made in such terms as to permit the State to select the land in choice, detached tracts. Thus better lands were obtained for higher education than could have been selected under the old requirement.

Still another provision of this act of Congress especially favored the promotion of higher education in Illinois. Instead of granting 5 per cent. of the proceeds derived from the sale of public lands for building roads, as had always been done, the act set apart only 2 per cent. for that purpose and 3 per cent. for the encouragement of learning, of which a sixth part should be exclusively bestowed upon a college or university.<sup>4</sup> The principal object of this provision was that immediate aid might be given to schools and to a college, which at that time were provided for only by the sale of waste lands.<sup>5</sup>

But so far as the establishment of a college was concerned, no steps were taken in that direction until the year 1833. In that year a bill to incorporate an institution under the name of Illinois University, and to endow it with the college and seminary funds, was introduced into the State Legislature, but was defeated. The cause of the failure of the bill was, as appeared at the time, due to the jealousy which it aroused among other colleges then in existence but not incorporated, which feared that they would be completely overshadowed by a well endowed State university. No doubt the opposition thus aroused helped to defeat the bill, but in the light of the accompanying legislation a more potent cause was the absence of the college and seminary fund.<sup>6</sup> The funds had

<sup>1</sup> W. L. Pillsbury: *Early Education in Illinois; Illinois School Report for 1895-96*, CXII.

<sup>2</sup> Pillsbury: *Ill. Sch. Rep.*, 1865-66, cv.

<sup>3</sup> *Ibid.*, 43.

<sup>4</sup> *Ibid.*, 44.

<sup>5</sup> *Annals of the 15th Congress*, April 4, 1848.

<sup>6</sup> Pillsbury: *Ill. Sch. Rep.*, 1896-96, cxii.

evidently been used up in defraying the expenses of the government, and could not at that time have been produced.<sup>1</sup>

The action of the State Legislature four years before, in their haste to dispose of the seminary lands, strengthens this view. In 1829 the Legislature had authorized the sale of these lands at public auction, with a minimum price placed upon them of \$1.25 an acre.<sup>2</sup> In a short time sixty-seven and a half out of the seventy-two sections were sold, and but three of them for more than the minimum price.<sup>3</sup> At this time there was no institution dependent upon the proceeds of these sales for support, nor, so far as can be learned, did the Legislature contemplate establishing one. As a matter of fact none was established for over a quarter of a century. It is evident from a careful review of the transactions of these few years that the State Government was in need of money to defray its expenses, and, rather than raise it by a tax upon the people, sold out at auction these lands appropriated by the Federal Government for the benefit of a seminary of learning.<sup>4</sup>

After the sale of the seminary lands the derived proceeds, together with the college fund, were borrowed at once by the State at six per cent. interest, the interest to be added to the principal until used.<sup>5</sup> This action on the part of the State confirms the view expressed above, that it needed money and adopted this means of obtaining it. It will be noticed further, that the addition each year of the interest to the principal was a mere nominal transaction. The transfer needed simply to be made upon the books. In 1835 it was provided that the interest should be loaned to the school fund for distribution over the State.<sup>6</sup> This continued until the establishment of the State Normal University in 1857, when the income of the college and seminary funds was turned over to it.<sup>7</sup> The State has never repaid the interest on the seminary fund during this period (1835-1857)<sup>8</sup> though it has paid that of the college fund.<sup>9</sup>

The proceeds of the sale of the seminary lands amounted in all to about sixty thousand dollars, and the interest on this for twenty-two years, which was never repaid, amounted to twenty thousand dollars.<sup>10</sup>

The college fund, or one-sixth of three per cent. of the proceeds of the sale of public lands, amounted to \$118,790. Part of the interest upon this was granted for the erection of the State Normal University build-

<sup>1</sup> For full discussion of this and the following, see Knight, 205.

<sup>2</sup> Illinois Laws.

<sup>3</sup> Pillsbury: Sketch of the Permanent Public School Funds of Illinois; Illinois School Report for 1881-82, cxxxvii.

<sup>4</sup> See Knight, 206.

<sup>5</sup> Illinois Laws, 11.

<sup>6</sup> *Ibid.*, 1-35, 23.

<sup>7</sup> *Ibid.*, 1-57, 399.

<sup>8</sup> Pillsbury: Illinois School Report 1881-82, cxxxiv.

<sup>9</sup> *Ibid.*, cxxxvii.

<sup>10</sup> *Ibid.*, cxxxix.

ing in 1857. The remainder of the interest up to 1882 was added to the principal, which at that date stood upon the State auditor's books at \$156,613.<sup>1</sup>

#### COLLEGES AND ACADEMIES.

The only assistance that the State of Illinois gave to higher education in this early period was in granting charters to academies and colleges. At first even these were not given without jealous restrictions;<sup>2</sup> for instance, no professor of theology was allowed to occupy a college chair, no theological department was to be created in any form, no religious test was to be made in the selection of trustees, etc., and the Attorney-General was especially authorized to proceed at once against any college corporation that should violate these restrictions in any respect. It is interesting to notice in this connection that the constitutions of Illinois down to the one of 1870 did not recognize the establishment of schools as a public function. The Constitution of 1848 indirectly recognized the usefulness of schools by giving the General Assembly power to exempt certain school or college property from taxation at discretion.<sup>3</sup>

The Legislature of 1840-41 abolished the above theological restrictions, and repealed the section which prohibited a college corporation holding land exceeding one square mile in perpetuity.<sup>4</sup>

The Legislature of 1842-43 passed a general law for the incorporation of colleges, and exempted ten acres of land owned by any literary institution from taxation, and for colleges and seminaries of learning 160 acres used as their location, including buildings and apparatus.<sup>5</sup> This same Legislature also founded the State Museum of Geology.

#### STATE NORMAL UNIVERSITY.

The State Normal University was established by an act of the Legislature February 18, 1857. As mentioned above, the interest on the college and seminary funds was appropriated to the university, except one-twenty-fourth per cent., which had previously been granted to the Deaf and Dumb Institute at Jacksonville.

The treatment of normal schools does not properly come within the scope of this work, but an exception must be made in the case of the normal schools of Illinois, for the reason that they were endowed with funds appropriated by Congress for a college and a seminary of learning. The president of the State Normal University, in the School Report for 1865-66, defends at some length the position that that institution was, in the dictionary sense of the term, a college, and a proper receptacle for the Congressional grant to the State of Illinois. The fact that there was occasion for such a defence indicates that this view was not universally accepted. Since, however, it was the State which put this construction upon the nature of the university, and since later it

<sup>1</sup> Pillsbury: Illinois School Report, 1881-82, cxxxvii.

<sup>2</sup> Willard, cxi.  
<sup>3</sup> Peore, 464.

<sup>4</sup> Willard, cxv.  
<sup>5</sup> Illinois Laws.

has made appropriations for the maintenance of the Southern Normal University, established in 1869, its aid to these institutions should be considered as an aid toward higher education.

The State of Illinois did nothing, however, toward the maintenance of the State Normal University, except to transfer the interest of the seminary and college funds to its support. In 1869 the Southern Illinois Normal University was incorporated, and since 1877 the income of both funds has been equally divided between the two normal schools.<sup>1</sup>

By the same act which incorporated the Southern Illinois Normal University seventy-five thousand dollars were appropriated to erect buildings.<sup>2</sup> In 1871 the State Legislature appropriated fifty thousand dollars,<sup>3</sup> and in 1873 eighty thousand dollars,<sup>4</sup> for the completion of the buildings. In 1885 one hundred and fifty thousand dollars<sup>5</sup> were appropriated for the rebuilding of property destroyed by fire.

#### GROWTH OF HIGHER EDUCATION.

Although no organized effort was made on the part of the State in the interests of higher education until very late in the history of Illinois, its need was felt and other means were found for supplying seminaries and colleges. As early as 1700 the French Jesuits are said to have founded a college at Kaskaskia. But this report is not to be accepted without reserve.<sup>6</sup> No trace of such an institution remains, and it is very probable that the college existed principally in name, and in the cherished hopes of its founders.

In the early part of this century, when Illinois was gradually becoming settled, academies endowed by private means sprang up in different parts of the State, followed later by colleges and seminaries similarly endowed. In 1841 there were in existence seven thriving colleges and forty-one academies.<sup>7</sup> The abolishing of certain restrictions upon colleges in this same year, and the extension of the rights of colleges to hold property a few years afterward, show that the State was beginning to awaken to the needs of a higher education. The establishment of the State Normal University in 1857 was a decided step taken in the direction of higher education by the State. Indeed, it is claimed that the movement which gave to the States their industrial colleges had its origin in Illinois. At all events, the project was first given tangible shape at a farmers' convention held in Granville, November 18, 1851, in which Prof. J. B. Turner, of Jacksonville, presented his "plan for an industrial university for the State of Illinois."<sup>8</sup>

We come now to the main effort made by the State of Illinois toward higher education, viz., in establishing

<sup>1</sup> Pillsbury, Ill. Sch. Rep., 1881-'82.

cxv.

<sup>2</sup> Illinois Laws.

<sup>3</sup> *Ibid.*

<sup>4</sup> *Ibid.*

<sup>5</sup> *Ibid.*

<sup>6</sup> Willard, xcv.

<sup>7</sup> Pillsbury, Ill. Sch. Rep., 1850-'51, cxl.

<sup>8</sup> *Ibid.*, 1881-'82, cxl.

## THE ILLINOIS INDUSTRIAL UNIVERSITY.

In accordance with the provisions of the act of Congress donating public lands to the several States, for the purpose of establishing agricultural colleges, the State Legislature in the early months of 1867 passed acts for the location, organization, and endowment of the Illinois Industrial University. By one of the provisions of the organization act, the Governor was empowered to appoint a board of trustees<sup>1</sup> consisting of five persons, resident in each of the judicial grand divisions of the State, together with one resident in each of the Congressional districts of the State. This board was a body corporate and politic, and had complete control of the financial management of the institution. At the first regular meeting the trustees were empowered to appoint a regent, who, together with the Governor, State Superintendent of Public Instruction, and president of the State Agricultural Society, should be *ex officio* members of the board of trustees. Said regent should be charged with the general supervision of the educational facilities and interests of the university, and his term of office should be two years.

Illinois received, according to her representation in Congress, four hundred and eighty thousand acres of land scrip. The endowment fund derived from this source was a little over four hundred and fifty thousand dollars, and about fifteen thousand acres of land located in Minnesota and Nebraska, value undetermined.

The scrip was turned over by the State to the trustees of the university. In consideration of the permanent location of the university at Urbana, Champaign County, it received the Urbana and Champaign Institute buildings and grounds, containing about ten acres. Also, one hundred and sixty acres of land adjacent thereto; also, four hundred acres of land . . . distant not exceeding one mile from the corporate limits of the city of Urbana. Also four hundred and ten acres of land . . . within one mile of the buildings herein offered. Also the donation offered by the Illinois Central Railroad Company, of fifty thousand dollars' worth of freight over said road for the benefit of said university. The university also received from the county over one hundred thousand dollars in bonds, fruit trees, shrubbery, etc. In all, the university received in consideration of its location an estimated amount of four hundred and fifty thousand dollars.

The first appropriation made by the State Legislature for the benefit of the State university was in March, 1869. The appropriation amounted to sixty thousand dollars in all, twelve thousand five hundred dollars per annum for two years to the agricultural department, ten thousand dollars per annum for two years to the horticultural department, five thousand dollars to the chemical department, and ten thousand dollars for apparatus, books, etc.

<sup>1</sup> Illinois Laws.

In April, 1871, an additional appropriation of one hundred and twenty-five thousand dollars was made; seventy-five thousand dollars for the erection of a main building, to contain a hall, library, geological, zoölogical, and botanical rooms, etc., twenty-five thousand dollars for the erection of a building for the mechanical department, five thousand five hundred dollars for chemical and mining departments, three thousand five hundred dollars for the horticultural department, sixteen thousand dollars for the agricultural, and ten thousand dollars for incidental expenses, apparatus, books, etc.

In 1873 an act was passed "making an appropriation in aid of the Industrial University and for payment of taxes on lands held by the State for the use of said institution." The whole appropriation amounted to twenty-one thousand dollars, one thousand five hundred dollars of which was in aid of experimental farming, and six thousand dollars for taxes on the lands held by the university.

An act to regulate the Illinois Industrial University and to make appropriations therefor was approved May 7, 1873. By this act some changes were made in the organization and management of the university. The number of trustees was changed to nine, of which a chosen three should constitute an executive committee, "who, when said board is not in session, shall have the management and control of the said university and its affairs." Instructions were given the treasurer by this act regarding part of the endowment fund, which was soon to become due. Also, provisions were made for obtaining the fifty thousand dollars' worth of freight donated by the Illinois Central Railroad to the university. Also, by this act the sum of \$44,550 was granted for the payment of the expenses incurred in the completion and furnishing of the main building.

In April, 1875, an appropriation of \$11,500 was made to be used in the payment of taxes, for apparatus for the physical laboratory, veterinary department, and printing establishment.

By an act of May 18, 1877, sixteen thousand dollars were appropriated for taxes on lands and current expenses, and fifty-three thousand dollars for new buildings, enlargements, etc.

This was followed by an act of May 22, 1879, appropriating \$24,500 for current expenses, taxes, improvements, etc., and by an act of May 28, 1881, granting \$40,300 for similar purposes. Current expenses were met in 1883-84 by an appropriation of \$54,500.

In June, 1885, the name of the Illinois Industrial University was changed by an act of the Legislature to that of the University of Illinois, the name by which it is known at the present time.

In 1885 an act approved June 27, 1885, appropriated \$53,500 for current and improvement expenses.

The last appropriation, made in 1887, granted \$26,666 for current expenses and repairs.

To sum up, the University of Illinois has received since its establish-

ment in 1867, five hundred and thirty-one thousand dollars in direct appropriations from the State. This sum together with the appropriation of four hundred and fifteen thousand dollars made to the Southern Illinois Normal University, which we have considered as coming within the scope of this work, constitutes the total material aid given for the benefit of higher education by the State of Illinois.

Slow at first to comprehend the benefits of a higher education, and to make use of the advantages in that line given to her by the Federal Government, Illinois has at last awakened to a sense of her needs, and is now making amends for her lost opportunities.

#### SUMMARY OF APPROPRIATIONS.

|                                                                     |           |
|---------------------------------------------------------------------|-----------|
| University of Illinois Industrial University:                       |           |
| Future State appropriations.....                                    | \$531,000 |
| Bonds of citizens of Urbana, and bonds of county, etc.....          | 400,000   |
| Illinois Central Railroad.....                                      | 50,000    |
| Illinois Normal University.....                                     | 415,000   |
| Total appropriations by the State for higher education.....         | 531,000   |
| State appropriations, including the Southern Normal University..... | 946,000   |

#### MICHIGAN.

The history of State higher education in Michigan centres around one institution. But that institution is the foremost university of the great West, and indeed the first model of a complete State university in America. The State has performed such an important part in the development of this university that a complete history of the legislation pertaining to it would extend beyond the compass of this paper; an attempt will be made to give only an outline of the important relations of the State to its establishment and support.

#### EARLY EDUCATION.

The founding citizens of Michigan in early times were of hardy New England stock, either emigrants directly from the far East or from the colony of Ohio. They carried with them the characteristics of their fathers in respect to their devotion to higher learning; they brought with them the sense of the great necessity of a system of education to insure the continuance of free institutions; they had an admiration for the highest means of culture.

With these ideas for a heritage, untrammelled by precedent and the binding force of custom they entered a new territory to build upon virgin soil a university to suit the needs of a growing community; consequently the struggle for intellectual elevation began at a very early date in the new settlements. There had settled about Detroit as early

as 1810 a company, about five thousand<sup>1</sup> souls, many of whom were of French descent and as a rule very illiterate. But there were among them Anglo-Americans of indomitable will and energy.

The population continued to increase slowly as the emigrants came toiling overland, or made their way through the Great Lakes or up the Mississippi, always receiving their provisions overland from Philadelphia. Although the Jesuits had settled in Michigan at a much earlier period<sup>2</sup> and established their missions, very little had been done toward education, and their illiterate French followers were calculated to be a hindrance rather than a help to any organized effort. There had been but little progress in this early period toward material comforts and less toward culture and learning.

But about the year 1816 there began to be decided thoughts expressed in favor of steps toward higher education, and in the following year, when the whole population did not number over seven thousand souls, an act was passed providing for the founding of and maintaining a university.<sup>3</sup>

Prior to this, in 1804,<sup>4</sup> when Michigan was organized as a Territory, Congress granted a township of land for a seminary of learning, and the university to be established in 1817 was to be in accordance with this grant.

The Territorial government committed the interests of higher education to the care of the Governor and the Judges, and it is supposed that through the exertions of Hon. A. B. Woodward,<sup>5</sup> then presiding Judge of the Supreme Court of the Territory of Michigan, that the act establishing a university was framed. A portion of this most curious document of the early history of Michigan will be given.

#### THE CATHOLEPISTEMIAD OR UNIVERSITY MICHIGANIA.

It is entitled "An act to establish the Catholepistemiad or University Michigania."<sup>6</sup>

*"Be it enacted by the Governor and Judges of the Territory of Michigan,* That there shall be in the said Territory a catholepistemiad or university denominated the Catholepistemiad or University Michigania.

The Catholepistemiad or University of Michigania shall be composed of thirteen didaxum or professorships; first, a didaxia or professorship catholepistemia, or universal science, the dictator or professor of which shall be president of the institution; second, a didaxia or professorship of anthropoglossica, or literature embracing all of the epistemon or sciences relative to language; third, a didaxia or professorship of

<sup>1</sup> Ten Brook, 95.

<sup>2</sup> A Jesuit mission was established at Sault Ste. Marie in 1668.

<sup>3</sup> Territorial Laws of Michigan, Vol. II, p. 104.

<sup>4</sup> United States Statutes at Large, Vol. VII, p. 166.

<sup>5</sup> Ten Brook, 90.

<sup>6</sup> Report of Superintendent of Public Instruction, Michigan, 1880, p. 360.



mathematica or mathematics; fourth, a didaxia or professorship of physiognostica or natural history, etc." The act thus continues through the whole range of the "thirteen didaxum;" the remaining nine are as follows: Natural philosophy, astronomy, chemistry, medical sciences, economical sciences, ethical sciences, military sciences, historical sciences, and intellectual.

The university was to be under the control of the professors and president, who were to be appointed by the Governor, while the institution was to be the center and controlling power of the educational system of the State. It was to be supported by taxation by an increase of the amount of taxes already levied, by 15 per cent. Also power was given to raise money for the support of the university by means of lotteries.

This remarkable document was not without its influence in shaping the public school policy of Michigan, but it was many years before the State approximated its learned provisions. Impracticable as this educational plan appears for a handful of people in the woods of Michigan, it served as a foundation upon which to build.

The officers and president were duly appointed, and the work of the new university began at once. At first the university appeared as a school board, to establish and maintain primary schools which they held under their charge. Then followed a course of study for classical academies, and finally, in October, 1817, an act was passed establishing a college in the city of Detroit called "The First College of Michigan." Thus the university had assumed control of the education of the State and had taken steps toward primary, secondary, and collegiate education. But, owing to its short duration and its want of adaptability to the needs of the Territory, the institution failed to accomplish much in practical education.

The people contributed liberally to these early schools, the sum of three thousand dollars being subscribed at the beginning. There was also a sum of five thousand dollars derived from the land grant made in the treaty of Fort Meigs in 1817.<sup>1</sup> The devotion of the people to education is seen in the following incident:

At the time in Detroit of 1805 certain sums of money were sent on from Montreal and Mackinaw for the relief of the sufferers. As the holders of the money could not obtain satisfactory security for the money, it was not given out, and the sufferers requested that it be given to the university.

An act was passed on the 30th of April, 1821, by the Governor and Judges establishing a university in Detroit to take the place of the early provincial and to be called the "University of Michigan." In its charter nearly all the powers of the former institution were substantially continued, except the provision for taxes and lotteries,<sup>2</sup> and in addition

<sup>1</sup> *Annals*, vol. 1, p. 11.

<sup>2</sup> Ten Brook, 102.

<sup>3</sup> *Annals of Michigan Territory*, vol. 1, p. 57.

the township of land granted by Congress and three sections obtained in the Fort Meigs treaty were placed under the control of the university. The new institution was made the legal successor of the old, and more conformable to the requirements of the use of the seminary lands as laid down in the ordinance of 1787.

It was not until May, 1824, that the first lands were located. Those of the three sections granted by the Fort Meigs treaty were located on the river below Detroit, and patents granted by the Government.

Difficulties arose pertaining to the location of the township for a seminary of learning, granted by Congress in 1804, and a committee was appointed to memorialize Congress and to petition for the removal of the difficulties<sup>1</sup> and location of the seminary lands. The memorial was successful, and Congress responded by an act<sup>2</sup> of May 20, 1826, authorizing the Secretary of the Treasury to set apart and reserve out of any of the public lands in the Territory of Michigan two townships of land for the endowment of a "seminary of learning" in lieu of the one township granted in 1804. A small portion of these lands was located by the Board of Education prior to the admission of Michigan as a State.

#### THE UNIVERSITY OF MICHIGAN.

The second corporation, known as the "University of Michigan," carried on the work of education already begun from 1821 to the third organization, in 1837.

The education was very limited, consisting in one classical academy at Detroit, and part of the time a Lancasterian school. The boards of education kept up and transmitted the university idea to such an extent that it may be said truly and legally that there was one University of Michigan, which passed through three successive stages of development marked by the dates 1817, 1821, and 1837.

After the organization of the State government the university passed through another transformation, and was placed under the control of a board of regents appointed by the Governor. The new organization succeeded to the property of the old, which consisted in the academy and lot in Detroit and private subscriptions.<sup>3</sup> The seminary lands were placed under the control of the Legislature.<sup>4</sup>

#### UNIVERSITY LAND ENDOWMENT.

For a full discussion of this subject the reader is referred to more extended histories of the University of Michigan. The annals of the institution have been well kept and recorded by careful historians.<sup>5</sup>

<sup>1</sup> One of the chief difficulties was that the lands must be located on lands freed from Indian titles at the time of the grant. As no such lands existed until after 1817, the township could not be located. Ten Brook, 106.

<sup>2</sup> United States Statutes at Large, Vol. IV, p. 180.

<sup>3</sup> Knight, 132.

<sup>4</sup> *Ibid.*

<sup>5</sup> See Ten Brook, C. K. Adams, and G. W. Knight.

Yet a brief outline of the subject must be given here to present the method adopted by the Legislature of Michigan for the disposal of the land grants.

It may be premised first that the public lands donated for a seminary of learning were almost invariably well located by the commissioners, were sold at a good price, but would have brought much larger returns had their sales been less hasty.

A committee appointed by the trustees of the university in 1827 reported favorably concerning lands on the Maumee River, and two sections were located and reserved where now is the city of Toledo, in Ohio.<sup>1</sup> These lands were very valuable, and there were consequently ready purchasers. The trustees, having obtained the permission of Congress, exchanged the most valuable half of this tract for less valuable lands in the vicinity of the grant. Thus 401½ acres were exchanged for 777 acres of less valuable land.<sup>2</sup>

Subsequently (1834) Mr. Oliver, with whom the lands were exchanged, bought back the tract (777 acres) which he had exchanged, paying for it the sum of five thousand dollars. For over four hundred acres of land now in the heart of the city of Toledo the trustees received the sum of five thousand dollars. The remainder of the tract was sold principally in 1844 and 1850, at an average price of over nineteen dollars per acre.

The Toledo lands, which are now worth millions of dollars, brought the paltry sum of seventeen thousand dollars.<sup>3</sup>

The Superintendent,<sup>4</sup> in his first report in 1837, suggested that the first twenty thousand acres of land would bring at once at least twenty dollars per acre, and the remainder would bring the same price when necessary for it to be sold. By an act of the Legislature approved March 21, 1837, the Superintendent was authorized to sell as much of the university lands as would amount to five hundred thousand dollars at a minimum price of twenty dollars per acre. The sales the following year show an average price of \$22.85 per acre, and the total amount received was more than one hundred and fifty thousand dollars.<sup>5</sup> This was an excellent beginning, and promised well for the university endowment.

But unfortunately there were difficulties to arise which would materially modify the estimates of results. It was found that very many of the best lands were already occupied by settlers, although the lands had been regularly located by the university.<sup>6</sup> The clamors of the settlers induced the Legislature to release 10,240 acres of said lands that had been located for eight years.

<sup>1</sup> This territory then belonged to Michigan, but was ceded to Ohio in 1836.

<sup>2</sup> *Michigan State Statutes at Large*, Vol. VI, p. 402.

<sup>3</sup> *Id.*, Vol. VI, p. 408.

<sup>4</sup> *Id.*, Vol. VI, p. 402.

<sup>5</sup> *Report of Superintendent*, 1839, 54.

<sup>6</sup> *Id.*, Vol. VI, p. 402.

The university in place of this was to receive an equal amount of land of the same value, but it was impossible to find it.<sup>1</sup> The best land had been chosen in 1830. In 1839 a bill passed both houses authorizing the sale of a large quantity of university lands which had been occupied by settlers, but the Governor wisely vetoed the bill and saved the university fund.<sup>2</sup>

By an act of 1840 three commissioners were appointed to investigate each claim, and if it could be shown that the claimant had settled on the land prior to its selection by the university the claimant should purchase the land at its appraised value, exclusive of improvements.<sup>3</sup> By its operation over four thousand acres were sold at an average price of six dollars and twenty-one cents per acre,<sup>4</sup> at a time when university lands were selling at twenty-four dollars per acre.<sup>5</sup> This brought to the university fund sixty-five thousand dollars less than would have been realized had the minimum price of 1837 been adhered to.<sup>6</sup> Again, in 1841, the minimum<sup>7</sup> price was reduced to fifteen dollars per acre, and in the following year to twelve dollars per acre, which was retrospective.<sup>8</sup>

By this last law the associate judges were authorized to examine any lands that had been sold previous to 1841 for twenty dollars per acre or more, and appraise such lands at their value at the time of the sale, and place the balance to the credit of the purchaser. By the report of the Superintendent for the year 1843<sup>9</sup> it appears that the sum of \$34,651 had thus been repaid to purchasers of university land. The total sales to this date had been two hundred and twenty thousand dollars, but the "effect of various acts of relief and retrospective legislation" reduced the amount to one hundred and thirty-seven thousand dollars.<sup>10</sup>

In the face of this adverse legislation the sum realized from the sale of the seminary lands amounted to about four hundred and fifty thousand dollars, or less than one-half of the anticipated amount. Still the average price per acre was, for the entire quantity sold, eleven dollars and eighty-seven cents, or more than twice that received for any other educational grant in the North-West Territory.<sup>11</sup>

In 1880 the account of the fund stood as follows:<sup>12</sup> all lands with the exception of 337.26 acres had been sold. There was in the hands of the State the sum of \$165,788.46. There was due from purchasers \$73,190.08, making the total university fund \$538,978.54, with an income of \$38,426.48.

In 1883 the lands were all sold but 287 acres, and the fund had increased to the sum of \$543,317.66.

<sup>1</sup> Report of Superintendent, 1880, 355.

<sup>2</sup> Senate documents, 1839.

<sup>3</sup> Laws of Michigan, 1-40, 101.

<sup>4</sup> Knight, 142.

<sup>5</sup> *Ibid.*

<sup>6</sup> Report of Superintendent, 1880, 355.

<sup>7</sup> Laws of Michigan, 1-41, 157.

<sup>8</sup> *Ibid.*, 1-42, 15.

<sup>9</sup> Superintendent's Report, 1-43.

<sup>10</sup> *Ibid.*, 1880, 356.

<sup>11</sup> Knight, 144.

<sup>12</sup> Superintendent of Instruction, 357.

## BRANCH SCHOOLS.

The extensive plan early entertained for the branch schools of the University of Michigan resulted in nothing further than the establishment of an excellent system of high schools, connected directly with the university curriculum, but entirely independent of the institution in their support and government.

It is evident that the originators of the plan had plainly in mind the gymnasia of Germany. The plan was very extensive. It was proposed to start eight branch schools.

The Superintendent of Public Instruction in his first report recommended that a branch school should be established in each county. The counties were to furnish buildings, then share equally with the regents in the support of these schools.

The Legislature enacted, in the main, according to the Superintendent's report: the branches were to be assisted in regard to philosophical apparatus, and one branch was to consist of a department for the higher education of females and a normal and agricultural department. Thus it was expected to form about one hundred colleges with a university at their head. In this extensive plan the university was to support itself and pay one-half of the expenses of the one hundred colleges on a prospective income arising from a capital which was not to exceed one million dollars at the highest estimate.

In the original law it was enacted that no branch school could be formed without the consent of the Legislature. This was changed in 1837: the power was delegated to the regents, and the regents gave the committee on branch schools full power to act.

It was immediately determined to start eight branch schools, and to appropriate eight thousand dollars for this purpose. Five hundred dollars was to be given to each, and the remainder distributed among the schools according to the number of the students in attendance at each.

Five of these schools, the first at Pontiac, were founded within the first year. The Superintendent's Report for 1841-42 shows that there were seven then in existence.

From 1837, the date of founding of the first school, to 1846, the regents spent the sum of \$45,945 on branch schools.<sup>1</sup> It began to be felt that this was all contrary to law, and in 1849 a resolution was offered in the Assembly discontinuing branch schools, but it was not acted upon. In the following year it was made a test case, without reaching any decision. However, it was evident to all that the practice was illegal, and the policy was changed.

It was not the intention of the Government that the seminary grant should be devoted to the support of one hundred colleges, but to found a seminary of learning. The funds were wisely returned to one channel for support of a central university for the State and during many years for the North West.

In 1870 a law was passed admitting students to the university who should complete the course in the various high schools and pass an examination before a properly constituted committee.

#### LEGISLATIVE ENDOWMENTS.

The University of Michigan received no State aid during the first thirty years of its existence, dating from the origin of its present organization in 1837. It was not until 1867, when the university had already become strong and renowned, when pupils were more numerous than those of any other institution in the land that the State was called to give the first penny to its support, and then the whole appropriation was fifteen thousand dollars a year, which was a tax of just one-twentieth of a mill on the appraisal of the taxable property of this rich Commonwealth. The total sum received by tax and drawn from the State treasury down to January, 1879, is in round numbers four hundred and sixty-nine thousand dollars.<sup>1</sup>

The State has recently generously compensated for its early delinquency in this respect. First of all must be mentioned the loan<sup>2</sup> of one hundred thousand dollars which the State made to the university in 1838. This sum was expended in buildings and apparatus, and by its use the university was prepared to open in 1844.

The loan was made with the hope of early repayment by means of the interest on the land endowment fund. The law provided that both principal and interest should be repaid from the income of the university fund. The loan was invested in twenty-year State bonds for the required amount.<sup>3</sup> But, as the payment of the interest on the loan absorbed a greater part of the income from the fund, the prospect of payment of the principal seemed hopeless.

In 1844 the Legislature accelerated the sales of lands by offering to accept in payment for them outstanding warrants against the State which could be purchased for fifty cents on the dollar. The State credited the university with the full legal price of the land which cost the purchaser just half as much. The university lost nothing by this. The purchasers were the direct gainers and the university the indirect gainer by the act.<sup>4</sup>

The law further provided that the loan might be paid from the principal of the university fund.

This was not in accordance with the provisions of the grant.

<sup>1</sup>The Higher Education, Pres. J. B. Angell. "The total appropriations of the State of Michigan to her university, up to date [1879], amount to \$1,842,142." Address on State Universities in the West, by Pres. James B. Angell, Proceedings of the Twenty-seventh Convocation, University of the State of New York, 1879.

<sup>2</sup>Joint documents, Mich., 1879.

<sup>3</sup>Michigan Laws, 1848, 248.

<sup>4</sup>Knight, 143. The university also had the opportunity of the direct benefit, for all of the warrants were accepted by the State from the university at par.

Interest on the loan was paid for some years until, in 1853, the State authorized the interest on the entire university fund to be paid to the university, thus virtually canceling the obligation of the latter. In 1877 the Auditor-General, by virtue of a resolution of the Legislature, made the loan on the records a part of the university fund.<sup>1</sup>

The endowment fund was not sufficient to provide for the growing needs of the university. The Legislature was made to see this in 1867 and accordingly passed an act in that year granting an annual appropriation of about fifteen thousand dollars, but with the following proviso that at least one homoeopathic professor should be appointed in the medical department.

Fearing that such a move would bring on a detrimental controversy, the university failed to accept the grant. Two years later the grant was made without the proviso, and the accumulations of the grant of 1867, amounting to over thirty thousand dollars, were paid.<sup>2</sup>

From this time on the Legislature has provided well for the university. Considering the heavy taxation Michigan has undergone, the university has received a liberal support.

In 1873 the appropriation of one-twentieth of a mill on each taxable dollar was made for a permanent endowment.<sup>3</sup> It is also provided that the amount paid to the university because of this act should not exceed fifty thousand dollars, and when the amount reached this sum it should be the annual assessment for the support of the university. Thus the Legislature gave from 1867 to 1873 the sum of fifteen thousand dollars per annum; from 1873 to present date one twentieth of a mill taxation on all assessed values; from 1875 six thousand dollars per annum for the support of the homoeopathic department.

Besides this, special appropriations have been made for various objects in the support of the several departments, as follows:<sup>4</sup>

|                          |             |
|--------------------------|-------------|
| In 1870 the sum of ..... | \$44,500.00 |
| In 1871 the sum of ..... | 49,000.00   |
| In 1872 the sum of ..... | 75,000.00   |
| In 1873 the sum of ..... | 88,000.00   |
| In 1874 the sum of ..... | 70,000.00   |
| In 1875 the sum of ..... | 47,500.00   |
| In 1876 the sum of ..... | 37,900.00   |
| In 1877 the sum of ..... | 27,200.00   |
| In 1878 the sum of ..... | 56,000.00   |
| In 1879 the sum of ..... | 51,500.00   |
| In 1880 the sum of ..... | 108,365.94  |
| In 1881 the sum of ..... | 46,700.00   |

<sup>1</sup> Report of Superintendent Public Instruction, 1886, 357. For a full discussion of this subject, see Ten Brook, 128, 135.

<sup>2</sup> In 1875 an annual endowment was fixed of six thousand dollars per annum for the support of the homoeopathic department, to be paid to the regents for

<sup>3</sup> L. S. Statutes, 1872, art. 1044.

<sup>4</sup> Taken from the president's reports. These appropriations are exclusive of the receipt from the one twentieth of a mill tax and the six thousand dollars appropriation for the homoeopathic department, except in case of 1880, which includes the former.

To show the direction of these appropriations a part of the act approved June 24, 1887, making these appropriations, will be given.

For the year 1887 the appropriations were made for the following purposes:<sup>1</sup>

|                                                      |            |
|------------------------------------------------------|------------|
| For repairs.....                                     | \$5 000.00 |
| Contingent expenses.....                             | 6,250.00   |
| Library and books.....                               | 5,000.00   |
| Homœopathic College and Hospital.....                | 6,200.00   |
| University Hospital.....                             | 5,000.00   |
| Dental College.....                                  | 8,000.00   |
| Apparatus for experiments in natural philosophy..... | 2,000.00   |
| Transportation and placing, Rogers's statuary.....   | 1,973.01   |
| Transportation and placing, Chinese exhibit.....     | 1,792.93   |
| Vault for chemicals, storage.....                    | 400.00     |
| Forge and foundry.....                               | 5,000.00   |
| Machinery in engineering laboratory.....             | 6,750.00   |
| Scientific, building and apparatus.....              | 35,000.00  |
| Boiler and boiler-house.....                         | 15,000.00  |
| For additional salaries.....                         | 5,000.00   |

Total of special appropriations..... \$108,365.94

To this amount should be added the sum of six thousand dollars, given annually by the act of 1875, and the sum of \$43,886.25, the amount received from the one-twentieth of a mill tax for the year 1887. This gives a total of \$158,252.19 raised by taxation and appropriated out of the public treasury for a single year, the largest sum given in any year.

According to a statistical table in the report of the Superintendent of Public Instruction of Michigan in 1880, the total amount received from the permanent funds, that is, from the United States grant, from the year 1839 to 1880, inclusive, was \$1,129,910.91. The income the first year, 1839, was \$9,433.13. The minimum amount raised was \$994.83 in 1843, and the maximum in 1879 was \$46,921.95.

As heretofore stated, the first appropriation from taxation was made available in 1869, the amount received in that year by the university from the State treasury being \$38,197.02. The total amount appropriated from 1869 to 1880, inclusive, was \$654,421.<sup>2</sup> The receipts from other sources amounted, during the period from 1839 to 1880, to \$622,634.97, less than the donations by taxation, and a little more than one-third of the entire income derived from the Federal and State grants.

#### THE STATE AGRICULTURAL COLLEGE.

The provisions of the Constitution of Michigan adopted in 1850 required that the Legislature "shall, as soon as practicable, provide for the establishment of an agricultural school."<sup>3</sup> This was the first step

<sup>1</sup> Report of president, 1887.

<sup>2</sup> This agrees approximately with President Angell's statement given above, the amount of the donation being \$155,375 for 1879 and 1880.

<sup>3</sup> Constitution of Michigan, 1850, Art. XIII, sec. 11.



taken toward the founding of the Agricultural College. Pursuant to the tenor of the Constitution a bill was introduced into the Legislature in 1853, but was lost in the House after passing the Senate. In 1853 the Legislature passed an act establishing the school, to be located within ten miles of the State capital, and granting twenty-two sections of the salt-spring lands for purchasing a farm and putting the school in operation.<sup>1</sup> The school was to be placed under the management of the Board of Education, and the executive committee of the State Agricultural Society were authorized to select a farm.

The committee selected 623.56 acres lying about three and one-half miles east of Lansing.

The State Board of Education, according to law, concluded the purchase for the sum of \$9,353.55, or at an average price of fifteen dollars per acre. Subsequently an adjoining tract of 53.01 acres was procured for the sum of \$1,059.92, making in the whole farm 676.57 acres, obtained at a cost of \$10,413.47.<sup>2</sup>

In 1856 buildings were erected, and the school was formally opened in May, 1857, with an attendance of sixty-one students. This was the first agricultural school opened in the United States.<sup>3</sup>

The minimum price fixed upon the twenty-two sections of the saline grant yielded the sum of \$56,320. The Legislature appropriated in 1857 the sum of forty thousand dollars to meet the needs of the institution. In 1858 the Legislature granted for the various uses of the college the proceeds of 6,961 acres of swamp lands which yielded a fund of \$42,396.87.<sup>4</sup>

The college thus so favorably started commenced a struggle against the prejudice existing in different parts of the State against a school of such nature. It was finally thought more fitting that the school should be under the control of the State Board of Agriculture, and in accordance with the desire of the State Board of Education the transfer was made in 1861.

It is to be noticed that the Legislature had petitioned Congress in 1850 for an endowment of three hundred and fifty thousand acres of land, but the request was not granted. Again, in 1858 the State Board of Education conjointly with the faculty of the college made a second petition for the same purpose. Although sanctioned by the Legislature, the petition was without avail. But the constant pressure brought to bear upon Congress by Michigan and other States in which the agitation of agricultural education was taking place led to the passage of a Congressional act, in 1858, granting twenty-five thousand acres for every member of Congress in the several States. This bill was vetoed by President Buchanan, but was passed and became a law with few

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Report of Superintendent Public Instruction, 1890, 374.

<sup>1</sup> *Ibid.*, 64, 65.

<sup>2</sup> *Ibid.*

<sup>4</sup> Joint documents 1858, No. 7, 33.

changes in 1832, the principal change being the increase of the number of acres granted to thirty thousand per Representative in lieu of twenty-five thousand. Michigan received by this grant two hundred and forty thousand acres. The minimum price of these lands was fixed at two dollars and fifty cents per acre in 1863, but in 1868, before the patents to the lands had been obtained, the minimum price was fixed at five dollars. In 1869 the price of agricultural lands was fixed at three dollars and forest lands at five dollars. A statement of 1880 shows that there remained unsold 151,345.45 acres, and the amount of the fund at that date was \$281,449.52, yielding an income of \$17,954.82. A later report shows that one hundred and six thousand acres had been sold at an average price of \$3.47 per acre, yielding net returns of \$367,117.24.

The remaining land (134,000 acres) is of good quality, and doubtless will yield a premium on the minimum price fixed, five dollars.

The total income from permanent funds prior to September 30, 1880, amounted to \$133,033.37 while the legislative appropriations reached the liberal figure of \$530,767.35 during the time from the school's organization (1855) to 1880.

The value of the buildings, apparatus, and grounds was estimated in 1880 by President Abbott to be two hundred and seventy-four thousand dollars.

The Agricultural College of Michigan differs but little from ordinary institutions of other States. It proposes to impart a knowledge of science in its application to the arts of life; to afford to its students daily manual labor; to prosecute experiments for the promotion of agriculture and horticulture; to afford a means of general education to the farming class, and finally, to afford instruction in the courses of study provided for by the act of Congress and the organic law of the college.

The full organization of the academic department of the University of Michigan has rendered it unnecessary that the literary courses in the Agricultural College be developed as fully as in like institutions of other States where thorough literary culture was wanting.

## SUMMARY OF GRANTS AND APPROPRIATIONS.

*The University of Michigan.*

|                                                                  |              |
|------------------------------------------------------------------|--------------|
| Total appropriations from 1867 to 1880 inclusive .....           | \$654,421.00 |
| From one-twentieth mill tax, 1880 to 1888 .....                  | 312,783.75   |
| Annual appropriations for homeopathic department (\$6,000) ..... | 48,000.00    |
| Special appropriations, 1880 to 1888 .....                       | 449,955.94   |
| Total State appropriations to University of Michigan .....       | 1,465,200.69 |

*Agricultural College.*

|                                                   |                |
|---------------------------------------------------|----------------|
| Appropriations from 1855 to 1880 inclusive .....  | 530,767.35     |
| Appropriations from 1880 to 1888, estimated ..... | 200,000.00     |
| Total appropriations .....                        | \$2,195,968.04 |

Calendar 1879. See Superintendent's Report 1880, 377.

## WISCONSIN.

## ORGANIZATION OF STATE UNIVERSITY.

In 1838, two years after organization as a Territory, Wisconsin petitioned Congress for aid to establish a university.<sup>1</sup>

The request was granted, the usual seventy-two sections of land were set aside for this object, and the Territorial Legislature at once passed a law establishing the University of the Territory of Wisconsin.<sup>2</sup>

The organization of a board of trustees was, however, the only other action which took place previous to the adoption of the State Constitution in 1848;<sup>3</sup> this provided for the establishment of a State university "at or near the seat of government," and stated, emphatically, that the lands granted for a university should constitute a perpetual fund, the income of which should be devoted to the support of this institution.<sup>4</sup>

## UNFORTUNATE MANAGEMENT OF LANDS.

This declaration was apparently to little purpose, as the State has treated these domains as granted absolutely, and not as held in trust.<sup>5</sup> There is probably no worse example of mismanaged public educational funds on record than is to be found in connection with this institution.<sup>6</sup> Proper committees were appointed by the Legislature of 1848 to appraise the lands at their true value,<sup>7</sup> and in the following year a law was passed<sup>8</sup> which provided for their sale at auction at prices ranging from \$1.13 to \$7.06 per acre, as appraised in 1848. No one questions the wise policy of this method of raising funds for the university, but the fact that the legislative body did, in 1849 and succeeding years, "dispose of large tracts of land for three dollars per acre which to-day would readily bring twenty-five dollars" is cause for just censure. Another strange action is chronicled in the Regents' Second Annual Report, dated January 16, 1850. Here it is stated that, while the school lands (every sixteenth section) were held at a value of \$3.44 per acre, the university lands, though well selected and of much better quality, were appraised at an average of \$2.78 per acre. In defence of their action the Legislature of 1849 claimed that low prices and rapid sales would be more favorable to the speedy accumulation of funds.<sup>9</sup> At the meeting of the Legislature in 1850, however, the sound principle

<sup>1</sup> History of Land Grants for Education in North-West Territory, G. W. Knight.

<sup>2</sup> U. S. Statutes, 244.

<sup>3</sup> G. W. Knight, 145.

<sup>4</sup> Constitution, Art. X, Sec. 6.

<sup>5</sup> Historical Sketch of University of Wisconsin, S. H. Carpenter, 12.

<sup>6</sup> *Ibid.*, 24.

<sup>7</sup> Wisconsin Laws, 1848, 123.

<sup>8</sup> North-West Territory, G. W. Knight, 145.

<sup>9</sup> *Ibid.*, 146.

was advanced that it would be wiser to accumulate a large sum, even though a longer time were required, and they accordingly raised the minimum price of all unsold land to ten dollars an acre, which caused a large increase in the proceeds of the next year's sales.<sup>1</sup>

But this advance in price resulted in such public dissatisfaction that the Legislature of 1851 was persuaded to change the price to seven dollars per acre, except where the land had been appraised higher (\$7.06) in 1848.<sup>2</sup> Some parties claiming this was too great a price for some of the land, and others that the sales were too much delayed, the Governor was authorized in 1852 to appoint commissioners to re-appraise the sections remaining; this was accomplished, and a minimum price of three dollars<sup>3</sup> an acre was fixed, which resulted in the speedy sale of the land not already taken.

After all of the various appraisals the entire sum realized from the 46,080 acres was only "about one hundred and fifty thousand dollars."<sup>4</sup>

#### FURTHER APPROPRIATION OF LANDS.

The University of Wisconsin was established in 1850<sup>5</sup> on the basis of the funds thus secured, but even while passing laws for the sale of the university lands the Legislature realized that the income would be insufficient to support the institution, and they therefore petitioned Congress for seventy-two additional sections in lieu of the saline lands granted to the State in 1848 but never located.<sup>6</sup>

Congress granted this petition in 1854,<sup>7</sup> and authorized the selection of the same number of sections from any of the public lands in the State for the benefit and aid of the State university. An opportunity to atone for past errors was now afforded the Legislature. It began to be realized, after it was too late to enact suitable laws to remedy the evil, that the best lands had been sold at a disadvantage. It was felt that, whereas the policy pursued had benefited the State at large, it was not faithful to the increase of the seminary fund. In 1872 the Governor boldly asserted that nine-tenths of the value of the fund had been sacrificed by hasty sales at low prices,<sup>8</sup> and the Legislature of that year is also deserving of praise for its honest courage in justly condemning the unfair policy hitherto pursued.<sup>9</sup> After fully examining the claims of the regents and the condition of the university in 1872 for four years, this body granted ten thousand dollars annually, to atone for the injustice done by the State in selecting for an endowment unproductive lands.<sup>10</sup>

<sup>1</sup> Knight's North-West Territory, 146.

<sup>2</sup> *Ibid.*, 147.

<sup>3</sup> Wisconsin Laws, 1852, p. 769.

<sup>4</sup> Historical Sketch, S. H. Carpenter, 41.

<sup>5</sup> Wisconsin Laws, 1851, 438.

<sup>6</sup> U. S. Statutes, vol. 10, 397.

<sup>7</sup> Governor's Message, 1872, 17.

<sup>8</sup> Wisconsin Laws, 1872, chap. 100, p. 114.

<sup>9</sup> *Ibid.*

<sup>10</sup> *Ibid.*

## RESTITUTION MADE IN 1876.

Finally, in 1876, the Legislature again records its disapproval of such measures and votes a permanent tax for the support of the university, declaring that "this tax shall be deemed a full compensation for all deficiencies arising from the disposition of the lands donated to the State by Congress in trust for the benefit of the university."<sup>1</sup> "Thus," says Knight, "has the mismanagement of earlier days entailed on the present and all succeeding generations a burden of taxation to compensate for early prodigality."<sup>2</sup>

## WRONG USE OF PRINCIPAL FUND.

Greater injury than even that wrought by unjust appraisal is, however, recorded in the legislative annals of 1862; here we find that the Legislature authorized the regents to use the principal fund to pay off the debt incurred in the erection of buildings.<sup>3</sup>

By the permission thus granted the sum of \$104,339.42 was taken from the fund.<sup>4</sup> This act was clearly in violation of the conditions of the grant and of the provisions of the Constitution, by both of which the proceeds of the land were to form a permanent fund for the support of the university.<sup>5</sup> But it is a great satisfaction to learn that in 1867 restitution was made for this injustice by the passage of a bill which appropriated annually for ten years the sum of \$7,303.76, this being the interest at seven per cent. upon the amount taken from the fund in 1862.<sup>6</sup> The charge of one thousand dollars which had been annually made to the university for the care of its funds was also now ordered discontinued, and the State treasurer was made treasurer of these funds without additional salary.<sup>7</sup> In 1882 about twenty-two hundred acres of the university lands were still unsold,<sup>8</sup> and the fund was \$228,438.84,<sup>9</sup> which was invested in Government and municipal bonds and in loans to various counties. Including the money used for the erection of buildings the proceeds of the sales in 1882 were \$333,778.25, or an average of \$3.71 per acre.<sup>10</sup>

## EARLY HISTORY OF THE UNIVERSITY.

The early history of this university was a period of great trial and disappointment. In 1849 the Legislature established the precedent of

<sup>1</sup> Wisconsin Laws, 1876, chap. 117.

<sup>2</sup> North-West Territory, 149.

<sup>3</sup> Wisconsin Laws, 1862, 168.

<sup>4</sup> Governor Wislizenus's Message, 1872, 17.

<sup>5</sup> Wisconsin Laws, 1875, chapter 2, p. 71.

<sup>6</sup> Historical Sketch of Wisconsin University, 50.

<sup>7</sup> Report of Commission on Public Lands, 1892, 6.

<sup>8</sup> Report of Secretary of State, 1882, 12.

annually granting the regents a sum which they deemed sufficient for necessary expenses,<sup>1</sup> but as many of the members were totally ignorant of the needs of the institution it could not be expected that they would be sufficiently liberal in their appropriations to meet the demands of a young and growing university.<sup>2</sup> The people at large were as ignorant of the condition and necessities of the university as many of the legislative body, and claimed with them that the institution was chiefly maintained in order to afford superior advantages to a few "aristocratic" young men<sup>3</sup> rather than for the good of the State. Notwithstanding such baseless jealousy and the parsimonious policy of the Legislature, the regents continued to labor zealously for the advancement of higher education.<sup>4</sup> Three separate reorganizations were successively attempted as the times seemed to demand, in 1858,<sup>5</sup> 1860,<sup>6</sup> and 1866, but it was not until the last that their efforts were notably successful.<sup>6</sup> Public opinion had by this time undergone an entire change. The people throughout the State saw their mistake in discouraging such an institution, and they now manifested a more liberal, friendly spirit, and were willing and anxious to give their influence to support the university. Under this happy condition of affairs the regents took courage, the course of study was enlarged and improved, the university being divided into the College of Letters and the College of Liberal Arts, with such professional and other colleges as might be added thereto or connected therewith. The Agricultural College which had been under discussion for years was now organized as an important department of the university,<sup>7</sup> and the income from the Agricultural College grant was pledged to the university as an endowment in addition to that which she already had from the seminary lands.<sup>8</sup> It is a strange fact that up to this date, 1866, not one dollar of State money had been devoted to university expenses.<sup>9</sup>

#### THE COLLEGE OF AGRICULTURE.

When the regents reorganized the university and incorporated this new department in 1866, they wisely arranged that a liberal education should precede the special instruction in agriculture. All students were therefore advised to pursue the same course of study until the end of the Sophomore year, when the agricultural course could be taken by those who preferred it.<sup>10</sup>

#### EXPERIMENTAL FARM.

As a necessary adjunct to the college just mentioned the Legislature wisely planned in 1866 for an experimental farm, which was to be pro-

<sup>1</sup> Historical Sketch of Wisconsin, 25.

<sup>2</sup> *Ibid.*, 27.

<sup>3</sup> *Ibid.*, 28.

<sup>4</sup> Regents' Report, 1855.

<sup>5</sup> *Ibid.*, 1860.

<sup>6</sup> Wisconsin Laws, 1866, chap. 114.

<sup>7</sup> North-West Territory, 146.

<sup>8</sup> Wisconsin Laws, 1866, 153.

<sup>9</sup> Historical Sketch of Wisconsin University, 48.

<sup>10</sup> Historical Sketch, 52.

vided "without expense to the State or to the funds of the university."<sup>1</sup> The county of Dane, in which the university is located, immediately claimed the honor of making the institution a gift of some two hundred acres of land lying near the university for this purpose, and spent forty thousand dollars for the farm and necessary buildings thereon.<sup>2</sup> Up to this period the entire support of Wisconsin University had been furnished by appropriations of the National Government and the funds resulting therefrom. The wisdom of this selection for the farm was that it best showed the adaptation of various soils and locations, and where the best kind and greatest quantity of a certain product could be obtained from a particular piece of land. For such practical reasons the experimental farm was far better than a model farm, for which this was not intended. The work of this department has been confined to the field of farm experiments covering the ordinary farm operations, instead of the more showy and striking experiments usually followed in such institutions and which prove more interesting to scientists than to farmers. Experiments have been conducted to determine the value of new varieties of grains and roots, the best method of seeding and cultivating, and the value of various manures. The results of these experiments are published annually in the report of the regents.<sup>3</sup>

#### FOUNDING OF THE LADIES' COLLEGE.

The university having passed through her period of discouragement is now attended with prosperity. In 1870 she received substantial assurance of the Legislature's newly-awakened interest in her behalf; this was the liberal donation of fifty thousand dollars for the erection of a Ladies' College, and is noteworthy as being the first State appropriation for university purposes.<sup>4</sup>

The old time prejudice against co-education long existed in Wisconsin, but the advanced ideas of the times would no longer exclude women, and we note their first admission to have been in 1860 when a class of thirty entered the normal department for a ten weeks' course of lectures. This school had been formally opened in 1856, but up to this time its activities had been entirely restricted to young men. From 1860 to 1863 the work in this department was suspended, but was finally resumed in 1864 with the opening of the department of theory and practice of elementary instruction, to which both sexes were admitted. The course now adopted remained in use until 1871, when the Ladies' College was completed, and young women were then granted the privilege of pursuing the studies of their own college with lady teachers or of entering the regular college classes.<sup>5</sup>

<sup>1</sup> Wisconsin Laws, Chap. 110, sec. 15.

<sup>2</sup> *Ibid.*, Chap. 110, sec. 15.

<sup>3</sup> Department of Education, Annual Report, 1867-68, 284.

<sup>4</sup> Wisconsin University, 1870.

<sup>5</sup> *Ibid.*, 1871.

The normal department of the university was thus transformed into a Ladies' College and the course of study was made to correspond with that in the College of Arts, except that substitutions were allowed for agriculture, calculus, analytical chemistry, and determinative mineralogy. But in 1873 these were discontinued, and ladies have since been permitted to take any study in the university course. The normal work of Wisconsin, which first began in the State university, is still actively carried on by five normal schools located respectively at Platteville, Whitewater, Oshkosh, Sheboygan, and Stoughton.<sup>1</sup>

#### DONATIONS BY THE LEGISLATURE.

Still continuing its new and generous policy the Legislature made in 1872 an annual appropriation of ten thousand dollars, of which we have spoken; again, in 1875, the university was aided by a gift of eighty thousand dollars from the State for the building of a Hall of Science, which was now deemed necessary to the highest success of the institution.<sup>2</sup>

The friends of the university were inspired with new hope to see this rapid growth and increase in usefulness; in 1876, as before mentioned, the Legislature still further redeemed its past record by adding to the yearly income.

This was done by voting an annual tax of one-tenth of a mill<sup>3</sup> on every dollar of taxable property in the State for university purposes.<sup>4</sup> The annual tax previously made, in 1867, has since this year (1876) been included in the tax just mentioned.<sup>5</sup> Up to the year 1883 the total amount of State donations, exclusive of that raised by the tax of one-tenth of a mill levied since 1876, has been \$235,769.84.<sup>6</sup>

#### FREE HIGH SCHOOLS.

It may be well to give a passing notice of the State appropriations for the encouragement of secondary schools in Wisconsin. There was an attempt made some years ago by several States to organize and support by State taxes a system of high schools immediately connected with the university. There now seems to be a tendency to delegate all control and support of high schools to local authorities and local taxation, respectively.

In order to increase the efficiency of this class of schools the Legislature of Wisconsin appropriated, in 1876, the sum of "twenty-five thousand dollars in the aid of free high schools,"<sup>7</sup> to be applied to towns,

<sup>1</sup> Department of Education, 1867-8, 757.

<sup>2</sup> Historical sketch of Wisconsin, 50, 56.

<sup>3</sup> By an amendment passed in 1883 this tax of one-tenth of a mill was changed to one-eighth of a mill. Wisconsin Laws, 1883, chap. 300.

<sup>4</sup> North-Western Territory, 164.

<sup>5</sup> Knight, 149.

<sup>6</sup> *Ibid.*, 164.

<sup>7</sup> Letter from State Superintendent J. B. Thayer, November 14, 1882.



cities, and villages that contained a graded school of two or more departments. "A second appropriation of twenty-five thousand dollars was made by the Legislature of 1885, and was limited to towns that contained no graded school of two or more departments."<sup>1</sup>

#### RECENT STATE ASSISTANCE.

From the State Superintendent of Wisconsin<sup>2</sup> we learn that at present the only annual sum paid to the State university is the income resulting from the tax of one-eighth of a mill upon every dollar of taxable property in the State; this amounts to about seventy-four thousand dollars per year. During the last three years, 1885-88, the Legislature has also appropriated the sum of three hundred and fifty thousand dollars to restore university apparatus, cabinets, and buildings which have been destroyed by fire. An annual appropriation, not to exceed fifty thousand dollars, is also given by the State to aid free high schools, but only about thirty thousand dollars of this amount is used each year; the grade of the school and character of the instruction given determine the portion each school receives.<sup>3</sup>

#### SUMMARY OF GRANTS FOR HIGHER EDUCATION.

|                                                                     |                |
|---------------------------------------------------------------------|----------------|
| For Ladies' College, 1870.....                                      | \$50,000.00    |
| For Hall of Science, 1875.....                                      | 80,000.00      |
| Annual grant of \$10,000 from 1872 to 1876.....                     | 40,000.00      |
| Interest on \$104,330.42, at 7 per cent, from 1877 to 1876.....     | 65,731.84      |
| Special grant to replace losses by fire.....                        | 350,000.00     |
| Amount of annual tax of one-tenth of a mill from 1876 to 1883.....  | 304,915.00     |
| Amount of annual tax of one-eighth of a mill from 1883 to 1888..... | 312,729.00     |
| Total for higher education.....                                     | \$1,203,377.84 |
| Grant for free high schools.....                                    | \$50,000.00    |

Under the provisions of chapter 117, Laws of 1876, the income from the tenth of a mill tax for the support of the University of Wisconsin, is as follows:

|           |          |            |           |
|-----------|----------|------------|-----------|
| 1877..... | \$42,359 | 1882.....  | \$44,780  |
| 1878..... | 42,359   | 1883.....  | 45,632    |
| 1879..... | 41,310   |            |           |
| 1880..... | 43,597   | Total..... | \$304,915 |
| 1881..... | 44,538   |            |           |

Since 1884 the eighth of a mill tax was as follows:

|           |          |            |           |
|-----------|----------|------------|-----------|
| 1884..... | \$57,412 | 1888.....  | \$72,656  |
| 1885..... | 59,549   |            |           |
| 1886..... | 61,017   | Total..... | \$312,729 |
| 1887..... | 62,663   |            |           |

<sup>1</sup> Letter from State Superintendent J. B. Thayer, November 14, 1888.

<sup>2</sup> J. B. Thayer, State Superintendent, letter from, dated July 23, 1888.

## CHAPTER VII.

### STATE EDUCATION IN THE SOUTH-WEST.

**The States of the South West** showed in general the same eagerness to found colleges and universities as that evinced by those of the North-West Territory. The famous Ordinance of 1787, which was so warmly supported by Southern men soon extended its privileges and influence to the newly admitted States of the South-West.

The conditions of the admission of Kentucky gave that State entire control of the public domain within its borders. But the Legislature, following after the example of Virginia, very early granted one-sixth of all the fees arising from the surveyor-general's office for the support of public education. Kentucky endowed early educational institutions with grants of public lands. Here, as in many other States, schools did not flourish owing to the rudeness of the times and the struggles for existence in attempts to subdue the forces of nature.

Tennessee received Federal grants of public lands for two colleges and a system of county schools. The early policy toward these institutions was encouraging and liberal. In modern times the Legislatures of Tennessee and Kentucky have done comparatively little for the support of higher education. Alabama and Mississippi have each received Federal land grants, and each has shown an earnest desire to found and maintain universities. The results are highly encouraging, though the amounts given for their support are not large.

Louisiana likewise received the benefit of the Federal grant for seminaries, and while yet a Territory, began to build a school system. The main plan was to assist in the founding and maintenance of academies and colleges throughout the State. A great deal of money was spent in this way and with no permanent benefit to higher education. At present, educational institutions are on a more permanent foundation and the liberality of the State is again manifesting itself after a long interval of comparative quiet.

In the South-West, educators and statesmen, zealous for the cause of education, had much to contend with in executing measures, no matter how excellent they might be, for the establishment of higher education. The sparsely settled rural districts, occupied by planters, the absence of large towns, the presence of the African race, and the absence of the sterling middle class of mechanics and tradesmen which characterizes

all countries of thrift, presented obstacles to education not easily overcome.

Texas retained the right to all of her public lands when admitted to the Union, but very soon gave a liberal land endowment for the establishment of universities. Since that time large tracts of land have been added to this grant which, if properly managed, will yield an income sufficient to fully equip and maintain a university. Funds are being appropriated by the Legislature for support of the university. Arkansas is now realizing the necessity of advanced learning, and is voting funds for the support of an industrial university. Upon the whole the outlook in the South-West is encouraging, although the work of building universities is only fairly commenced by the States.

## KENTUCKY.

### EARLY EDUCATION.

Although Kentucky was, to use Professor Shaler's expression, "a poor country of wealth," the interests of education were by no means neglected. As early as 1792, the year of Kentucky's admission to the Union, we find the Legislature authorizing Salem Academy to raise five hundred dollars by a lottery.<sup>1</sup> The policy of the State, thus early indicated, comes out more strongly in the acts of 1798. In February of that year, six thousand acres of land, free from taxes, were granted to each of six academies and seminaries, and all unappropriated lands, south of the Cumberland River and east of Obey's River, were reserved for future appropriation to seminaries of learning.<sup>2</sup> Soon afterward the Transylvania Seminary was authorized to raise five thousand dollars by a lottery, and in December nineteen academies were chartered, each to receive five thousand acres of land and the privilege of raising not more than five thousand dollars by a lottery. The land thus granted was to be divided by lot, and by subsequent acts each county in the State received a certain number of acres for a county academy.<sup>3</sup>

Thus the means for a free secondary education was thus provided for, but, as yet, no provision was made for the promotion of higher instruction.

### TRANSYLVANIA UNIVERSITY.

The Transylvania University was formed by a union of the Transylvania Seminary and the Kentucky Academy in 1798. It may be stated that the latter was chartered in this year. The Transylvania Seminary

<sup>1</sup> *Acts of the General Assembly of the State of Kentucky*, 1792, 17.

<sup>2</sup> *Acts of the General Assembly of the State of Kentucky*, Laws of 1798, 17.

<sup>3</sup> *Acts of the General Assembly of the State of Kentucky*, Laws of 1798, 17.

nary was organized in 1783, but for many years did not flourish; in fact, the seminary maintained a struggle for existence.<sup>1</sup> The rudeness of the times, the attention required to protect the homes of the settlers from the Indians, the force required to subdue the wilderness, required all of the native strength of this new country; but we find the Legislature at this early period encouraging education. The seat of the seminary was removed to Lexington in 1788, where it was hoped it would have better advantages. The Legislature gave an endowment of twenty-eight thousand acres<sup>2</sup> of land, and subsequently, in 1790, donated to the college one-sixth of the surveyor's fees.<sup>3</sup> After its union with Kentucky Academy, under the name of university, it was in a more flourishing condition, and performed a service to the State for many years.

Transylvania University received the first assistance from the State in 1819, when it was granted for two years the proceeds of the tax on the Farmers and Mechanics' Bank of Lexington.<sup>4</sup> The next few years abound with similar provisions. In 1820 five thousand dollars was granted for the use of the medical department,<sup>5</sup> and it was directed that all fines and forfeitures to the Fayette County court should be paid over to the university.<sup>6</sup> This assistance proved insufficient, and the university fell into debt. So, in 1821, it was given one-half of the clear profits accruing on the loans of the Branch Bank of the Commonwealth at Lexington until the university's debts should be discharged; the trustees were ordered to manage it without a view to further donations from the Legislature.<sup>7</sup> In 1822 the medical department was authorized to raise twenty-five thousand dollars by a lottery.<sup>8</sup> To procure a library for the law department a tax of two per cent. was laid on all sales at auction in Fayette County.<sup>9</sup> This law remained in force several years. We meet it again in 1833,<sup>10</sup> and in 1856 it was re-enacted.<sup>11</sup> In 1830 all escheatable property in the county was vested in the university.<sup>12</sup>

The relation of the State to Transylvania University is also shown by the frequent appointment of a committee by the Legislature to visit

<sup>1</sup> Life and Times of Judge Caleb Wallace, 122. Henning's Statutes of Virginia, XI, 262.

<sup>2</sup> *Ibid.*

<sup>3</sup> *Ibid.*, 123. This law was similar to that of Virginia which gave one-sixth of the surveyor's fees to William and Mary College. (See Virginia.)

<sup>4</sup> Laws of 1819, 692.

<sup>5</sup> Laws of 1819, 952.

<sup>6</sup> *Ibid.*, 976. The act provided that all fines and forfeitures to the county courts should go to the county seminaries. In the counties where there were no seminaries, the colleges were the beneficiaries. It was repealed by the act of 1838, by which fines and forfeitures went to form a jury fund. Laws of 1837-38, 248.

<sup>7</sup> Laws of 1821, 351.

<sup>8</sup> Laws of 1822, 149.

<sup>9</sup> *Ibid.*, 160.

<sup>10</sup> Laws of 1832, 103.

<sup>11</sup> Laws of 1856-56, II, 451.

<sup>12</sup> Laws of 1830, 261.

it and report on its condition. This institution exercised an important educational influence in Kentucky, but finally died out, a victim to sectarian prejudice.<sup>1</sup>

#### SOUTHERN COLLEGE OF KENTUCKY.

In 1819 the Legislature incorporated four colleges,<sup>2</sup> and, of these, two received public assistance.

In 1821 the Southern College of Kentucky, at Bowling Green, was given one-third of the clear profits from the Branch Bank of the Commonwealth there located, so far as the same were derived from borrowers in Warren County. This was to continue for two years.<sup>3</sup> In 1826 the college was granted six thousand acres of unappropriated land.<sup>4</sup>

#### CENTRE COLLEGE.

This college, the other institution of this year that received State aid, was incorporated with the funds of Danville Academy. Its charter contained a provision that it could subsequently be adopted as a State institution.<sup>5</sup> It received the same share of bank profits as Southern College, but the bank was the one at Harrodsburg, and the county that of Mercer.<sup>6</sup> It passed into Presbyterian control in 1824, and the money received from the Harrodsburg Bank was directed to be paid to the Deaf and Dumb Asylum.<sup>7</sup> In 1843 Congress granted Centre College the township of land which it had, in 1826, given to the Deaf and Dumb Asylum.<sup>8</sup>

#### AUGUSTA COLLEGE.

This college, located in the town of the same name, was incorporated in 1822.<sup>9</sup> In 1825 it received six thousand acres of unappropriated lands.<sup>10</sup> Two years later we find an interesting enactment allowing the trustees to establish a ferry across the Ohio at Augusta, for the benefit of the college.<sup>11</sup> This act also fixed the rates of fare, and created a monopoly by declaring that there should be no other ferry within a mile and a half. In 1834 the college received ten thousand dollars from the funds of Bucken Academy.<sup>12</sup>

<sup>1</sup> Shaler's Kentucky, 329.

The other colleges were Urania College at Glasgow, Western College of Kentucky, at Hopkinsville (laws of 1818, 737), and Centre College at Danville.

<sup>2</sup> Laws of 1821, 355.

<sup>3</sup> Laws of 1821, 94.

<sup>4</sup> Laws of 1826, 618. This provision was also embodied in the charter of Southern College.

<sup>5</sup> Laws of 1821, 354.

<sup>6</sup> Laws of 1821, 64.

<sup>7</sup> Statutes at Large, VI, 339, 886.

<sup>8</sup> Laws of 1822, 163.

<sup>9</sup> Laws of 1822, 99.

<sup>10</sup> Laws of 1826, 39.

<sup>11</sup> Laws of 1823, 739.

## SHELBY COLLEGE.

A college was chartered at Shelby by an act of 1836, and the following year it was given permission to raise one hundred thousand dollars by a lottery.<sup>1</sup> The proceeds of this lottery were afterwards ordered to be invested in stocks.<sup>2</sup> This institution became St. James College in 1868.<sup>3</sup>

## CONCORD COLLEGE.

From the Reports of the Commissioner of Education we learn that Concord College, at New Liberty, received annual appropriations from 1875 to 1879, varying from two hundred and forty to six hundred dollars.

## THE STATE COLLEGE.

Kentucky accepted the land grant for agricultural colleges (three hundred and thirty thousand acres) early in 1863,<sup>4</sup> and in the same year a committee was appointed to locate the college.<sup>5</sup> In 1865 the trustees of Transylvania University and those of Kentucky University at Harrodsburg gained permission to unite the two institutions at Lexington under the name of Kentucky University, and to establish the Agricultural and Mechanical College as a department of this. The financial prospects of this skillful patchwork were encouraging. The land scrip was sold for \$164,960, and this, with the endowments of the two universities and the amount raised by subscription, formed a capital of over five hundred thousand dollars, mostly invested at six per cent. Twenty thousand dollars was loaned by the State to put the Agricultural College into immediate operation.<sup>6</sup>

The connection with Kentucky University proved unfortunate. A fierce religious war broke out when the institution was getting well under way, and in 1878 the two colleges were separated and commissioners appointed to select a new location for the Agricultural College.<sup>7</sup> Lexington offered the most favorable terms and the college was located there.<sup>8</sup> It is generally known as Kentucky State College and is, with but one possible exception, the best educational institution in the State.

An assured financial basis was given by an act of 1880, in passing

<sup>1</sup> Laws of 1836-37, 219.

<sup>2</sup> Laws of 1837-38, 129.

<sup>3</sup> Private laws of 1867-68, I, 353. Another college was founded in 1836, Columbia College, and the fines and forfeitures in Adair County, previously vested in Robertson Academy, were given it. Laws of 1836-37, 199.

<sup>4</sup> Private laws of 1861-62-63, 335.

<sup>5</sup> 1864, 371.

<sup>6</sup> On the organization of the Agricultural College, see the Report of the U. S. Commissioner of Education for 1867, 164-167, 291; Shaler's Kentucky, 361, 362, 400; Public laws of 1865, 15 ff., 67, 68; Public laws of 1865-66, 29.

<sup>7</sup> Shaler, 400; Public laws of 1878, 46.

<sup>8</sup> Public laws of 1879, 5, 18.

for the benefit of the college, a tax of five mills on each hundred dollars of property liable for State taxation.<sup>1</sup> Colored citizens are not subject to this tax, as only white students are admitted to the college. The annual income from the land scrip fund is nine thousand nine hundred dollars; from the State tax twenty-four thousand dollars is annually received.<sup>2</sup>

#### **EXEMPTION FROM TAXATION.**

Educational property is not subject to taxation by virtue of an act of 1869, which declares that "all college buildings and seminaries of learning, and all the real estate, not exceeding five acres, and all the personal property of every kind belonging to any institution of learning within this State, shall be exempt from taxation for any purpose whatever."<sup>3</sup>

#### **CONCLUSION.**

The attitude of Kentucky toward higher education has been favorable. Financial assistance has been given by direct grants of money and by permission to hold lotteries, but the usual way has been to set apart definite sources of revenue for particular institutions. Until Transylvania University was discontinued, it was the chief object of the State's generosity; from 1865 to 1878 State education had its centre in Kentucky University; for the last ten years the State College has been the beneficiary.

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#### **TENNESSEE.**

##### **INTRODUCTORY**

"The history of the common schools is, in the main, the history of public lands in Tennessee, and the history of public lands in this State is the history of confusion."<sup>4</sup> This, the opinion of Tennessee's latest historian, is also applicable to the higher education, since its history, too, is closely connected with that of public lands.

In its early period the State of Tennessee was unable to give assistance to education; to use the words of the State Senate in 1801, replying to the petition from the University of North Carolina, "Tennessee . . . has not arrived at the period when her revenues will even authorize a loan to patronize the seminaries of learning already established within the limits of her own State."<sup>5</sup> Accordingly, the first aid to higher education came from the Federal Government.

By the act of 1806, Congress granted certain lands to Tennessee for educational purposes. One hundred thousand acres of these lands

<sup>1</sup> Public laws of 1869, 157.

<sup>2</sup> *Annals of Tennessee*, James K. Peterson.

<sup>3</sup> Public laws of 1869, 157.

<sup>4</sup> Public laws of 1820-70, 2.

<sup>5</sup> Phelan, *History of Tennessee*, 233.

<sup>6</sup> *Ibid.*, 235.

were to be located in one body and sold for not less than two dollars an acre, the proceeds to go for the use of two colleges, one in East and one in West Tennessee.<sup>1</sup> The provisions of the act were not closely adhered to. The lands were laid out in detached parcels and sold on credit for one dollar an acre. Even then, only a small part of the proceeds was received.<sup>2</sup> The money that came in first was loaned out to individuals,<sup>3</sup> but in 1813 it was called in and paid over to the colleges, to be invested in bank stock.<sup>4</sup> The payments for lands came in slowly, and in consideration of the delays sustained by the colleges, the Legislature in 1823 vested in the two colleges, equally, one-half the money due on May 1, 1824, as proceeds of the land sold for the benefit of the State. On the basis of these lands the two colleges started.

## UNIVERSITY OF NASHVILLE.

The germ of this institution was in existence before Tennessee became a State. By an act of 1785 North Carolina incorporated Davidson Academy and granted two hundred and forty acres of land near Nashville for its support.<sup>5</sup> In 1806 the funds and property of the academy were given to the college established in West Tennessee in accordance with the Congressional land grant. The new college, which was called Cumberland College, was to have one-half of the one hundred thousand acre appropriation, and its property was to be exempt from taxation.<sup>6</sup> Instruction was begun in 1809, but the poor management of the land grant caused the institution, in 1816, to suspend its exercises for want of money.<sup>7</sup> When, ten years later, it again opened its doors, it was as the University of Nashville, with power to raise two hundred thousand dollars by a lottery.<sup>8</sup> In 1838 the Legislature granted the university eleven thousand five hundred and twenty acres of land, in lieu of all its claims against the State, and in this way forty thousand dollars was realized.<sup>9</sup>

For many years the University of Nashville was one of the most powerful educational influences in the South-West, but difficulties arose, and in 1875 the trustees were allowed to discontinue instruction as then given, and convert the institution into a scientific or normal school.<sup>10</sup>

<sup>1</sup> U. S. Statutes at Large, II, 581; Phelan, 235; Report of the U. S. Commissioner of Education for 1876, 379. The act also granted one hundred thousand acres for the use of academies, one in each county, and six hundred and forty acres in every six miles square for the use of schools.

<sup>2</sup> Phelan, 288.

<sup>3</sup> Scott's Laws of Tennessee, I, 1122.

<sup>4</sup> *Ibid.*, II, 166.

<sup>5</sup> Phelan, 137.

<sup>6</sup> Scott's Laws, I, 929.

<sup>7</sup> Phelan, 238.

<sup>8</sup> Phelan, 279. Laws of 1826, 34, 46.

<sup>9</sup> *Ibid.*, 238. Laws of 1838, 287.

<sup>10</sup> Laws of 1875, 157.



## UNIVERSITY OF TENNESSEE.

The origin of the University of Tennessee goes back to 1794, when Blount College was formed, near Knoxville.<sup>1</sup> In 1807 the funds of Blount College were merged with the endowment granted by the act of Congress of 1806, and East Tennessee College was the result.<sup>2</sup> The finances of the college were for several years following involved in the land sales, from which they received very little benefit.

The next assistance granted the college was also Federal. The share of Tennessee in the land granted for agricultural colleges was three hundred thousand acres. East Tennessee University (the college had become a university in 1840),<sup>3</sup> was made the recipient of the land scrip, the proceeds of which were invested in Tennessee 6 per cents.<sup>4</sup> A small part of the proceeds was held back by the State and used for other purposes, but the claim was satisfied in 1881 by a grant of \$3,775.<sup>5</sup>

The whole endowment from the land-scrip fund is now invested in three hundred and ninety six State bonds of one thousand dollars each, bearing interest at six per cent.<sup>6</sup> The name of the institution was changed to the University of Tennessee in 1879.<sup>7</sup>

## OTHER COLLEGES.

In 1846 the United States released its title to certain land in Tennessee, on condition that the State should, out of the proceeds, set apart forty thousand dollars toward the establishment of a college at Jackson. Accordingly, in the next year the treasurer of the State was directed to issue to West Tennessee College at Jackson a warrant for that sum. The institution was discontinued in 1873, and in 1874 its buildings were occupied by the South-Western Baptist University.<sup>8</sup> In 1875, we are told, Mosheim Male and Female Institute received \$1,255 from the State.<sup>9</sup> In 1876 King College at Bristol received \$1,800.<sup>10</sup>

In 1881 the Legislature set aside \$2,500 annually in scholarships to approved institutions of learning for higher and normal education of children of African descent.

## EXEMPTION FROM TAXATION.

The Constitution of Tennessee allows the Legislature to exempt from taxation property held and used for educational purposes.<sup>11</sup> Instances of such action are noted in 1836 and 1882.<sup>12</sup>

<sup>1</sup> Laws of 1794, Session of 1792.

<sup>2</sup> Laws of 1807, 1804.

<sup>3</sup> Laws of 1840, 18.

<sup>4</sup> Laws of 1806, 41; Laws of 1867, 68.

<sup>5</sup> Laws of 1881, 12.

<sup>6</sup> Laws of 1881, 12.

<sup>7</sup> Laws of 1879, President Dyer, 16.

<sup>8</sup> Laws of 1874, 78.

<sup>9</sup> Laws of 1875, 87.

<sup>10</sup> Statutes at Large, IX, 66.

<sup>11</sup> Laws of 1847, 68.

<sup>12</sup> Report of United States Commissioner of Education for 1875, 401.

<sup>13</sup> *Ibid.*, 402.

<sup>14</sup> *Ibid.*, 1876, 378.

<sup>15</sup> Laws, extra session of 1881, 7.

<sup>16</sup> Art. II, sec. 28. Poore, *Charters and Constitutions*, 1700.

<sup>17</sup> Laws of 1836, 59. Laws of second extra session of 1882, 6.

## CONCLUSION.

If we can judge by the utterances of the Legislature, Tennessee once contemplated an extensive system of State education. In the preamble to an act of 1817, regulating academies and colleges, we read that "institutions of learning, both academies and colleges, should ever be under the fostering care of this Legislature, and in their connection with each other form a complete system of education."<sup>1</sup> This high ground, so early taken, was not maintained. Twenty years later, we find a report to the General Assembly attributing the lack of State aid to the prejudice which prevailed against higher institutions of learning.<sup>2</sup> Whatever may be the cause, the fact remains that, with slight exceptions, Tennessee has given no direct aid to higher education. The activity of the State has been almost entirely confined to taking charge of Federal grants.

## ALABAMA.

## UNIVERSITY OF ALABAMA.

Alabama Territory was formed from Mississippi in 1817.<sup>3</sup> The following year Congress reserved one township of land for the endowment of a seminary of learning;<sup>4</sup> and in 1819, when Alabama was admitted as a State, another township was granted.<sup>5</sup> The attitude of the State toward these donations is seen in its first Constitution. After providing for the support of schools and care of school lands, the Constitution of 1819 directs as follows :

"The General Assembly shall take like measures for the improvement of such lands as have been or may be hereafter granted by the United States to this State, for the support of a seminary of learning, and the moneys, which may be raised from such lands, by rent, lease, or sale, or from any other quarter, for the purpose aforesaid, shall be and remain a fund for the exclusive support of a State university, for the promotion of the arts, literature and the sciences; and it shall be the duty of the General Assembly, as early as may be, to provide effectual means for the improvement and permanent security of the funds and endowment of such institution."<sup>6</sup>

The lands were immediately leased and the proceeds set apart for a seminary of learning.<sup>7</sup> In striking contrast to the waste of educational resources in some States, we find Alabama taking measures to secure the full benefit of her land endowment. An act of 1820 provided that

<sup>1</sup> Scott's Laws, II, 331.

<sup>2</sup> Phelps, 226.

<sup>3</sup> U. S. Statutes at Large, III, 371.

<sup>4</sup> *Ibid.*, 467.

<sup>5</sup> *Ibid.*, 491.

<sup>6</sup> Art. VI, Education. — Boore, Charters and Constitutions, 43. Report of Commissioner of Education for 1867, 107.

<sup>7</sup> Laws, second session of 1818, 43. — Laws of 1819, 60.

the yearly rent of the seminary lands should not be less than two dollars an acre.<sup>1</sup> When the lands were sold, the minimum price was at first fixed at seventeen dollars an acre,<sup>2</sup> but later they were divided into three classes, to be sold at not less than seventeen, twelve, and eight dollars an acre, respectively.<sup>3</sup>

The first move toward establishing the university was made in 1810, when commissioners were appointed to select a site.<sup>4</sup> Tuscaloosa was chosen as the location, and in 1821 the university was incorporated.<sup>5</sup> The proceeds of the land sales were invested in stock of the Bank of Alabama, and were guaranteed by the State.<sup>6</sup> In 1848 the amount of the university fund was declared to be two hundred and fifty thousand dollars, on which the State pledged to pay interest at six per cent. forever.<sup>7</sup> After the State capital was removed to Montgomery, the university received the rent of the old State House at Tuscaloosa.<sup>8</sup> In 1860 fifty thousand dollars was added to the university fund, and six per cent. interest on this amount since 1848 was directed to be paid to the university, on condition that the trustees should establish a military department.<sup>9</sup> To increase the efficiency of this department, interest on the university fund was raised, the following year, to eight per cent.<sup>10</sup>

Since the War, donations have been made to the amount of one hundred and thirty thousand dollars.

#### MOBILE MEDICAL COLLEGE.

In 1850 this institution was established as a branch of the State University and given fifty thousand dollars.<sup>11</sup> Other grants have been made, amounting to \$17,250.

#### AGRICULTURAL AND MECHANICAL COLLEGE.

The acceptance of the agricultural land grant was provided for by the Constitution of 1867.<sup>12</sup> The grant consisted of two hundred and forty thousand acres, which were sold for a net sum of two hundred and sixteen thousand dollars. East Alabama College at Auburn offered its entire property, amounting to over one hundred thousand dollars, in buildings and lands, in case the new college should be located there.<sup>13</sup> The offer was accepted, and Alabama Agricultural and Mechanical College was established in 1872.<sup>14</sup> The State has given \$42,500 in money, and the college gets one-third of the tax on fertilizers, which has

<sup>1</sup> Laws of 1820, 4.

<sup>2</sup> Laws of 1822, 26.

<sup>3</sup> Laws of 1825, 3.

<sup>4</sup> Laws of 1810, 64.

<sup>5</sup> Laws of 1821, 1.

<sup>6</sup> Laws of 1818, 2, 3, 10.

<sup>7</sup> Laws of 1848, 1, 7.

<sup>8</sup> Laws of 1857-58, 271.

<sup>9</sup> Laws of 1859-60, 25.

<sup>10</sup> Laws, extra session of 1861, 56.

<sup>11</sup> Laws of 1850-51, 348.

<sup>12</sup> Art. XI, sec. 14, Poore, 73. Report of Commissioner of Education for 1867, 126.

<sup>13</sup> Catalogue of the Agricultural and Mechanical College for 1872.

<sup>14</sup> Laws of 1871-72, 64.

yielded it nearly forty thousand dollars.<sup>1</sup> The interest on the land-scrip fund was in 1883 twenty-four thousand dollars.<sup>2</sup>

#### CONSTITUTIONAL PROVISIONS.

Besides the provisions of 1819 and 1867 already cited we find the Constitution of 1875 guaranteeing the inviolability of all educational funds,<sup>3</sup> regulating the trustees of the University of Alabama and the State Agricultural and Mechanical College,<sup>4</sup> requiring a two-thirds vote of the Legislature to change the location of these institutions,<sup>5</sup> and permitting that body to exempt educational institutions from taxation.<sup>6</sup>

#### SUMMARY.

Alabama has been liberal in assisting higher education. Federal grants have been well administered and increased by State benefactions. Exclusive of the interest on the university fund and the land-scrip fund, the following aid has been given:

|                                          |           |
|------------------------------------------|-----------|
| University of Alabama <sup>7</sup> ..... | \$130,000 |
| Mobile Medical College.....              | 67,250    |
| Agricultural and Mechanical College..... | 92,500    |
|                                          | <hr/>     |
|                                          | \$279,750 |

#### MISSISSIPPI.

##### JEFFERSON COLLEGE

It is gratifying to see the attention paid to education by the early settlers of Mississippi. The Territory, then comprising all of Alabama and Mississippi between thirty-first degree and the mouth of the Yazoo, was organized in 1798,<sup>8</sup> and by an act of May 10, 1800, Congress authorized the first Territorial Legislature.<sup>9</sup> Before three years had passed, this body made provision for the establishment of a college, to be known as Jefferson College.<sup>10</sup> The institution was located at Washington, and its property was free from taxes. The trustees were permitted to raise ten thousand dollars by a lottery and to collect subscriptions for the college. In an act of 1803, regulating the disposal of

<sup>1</sup> Letter from President Brown, November 30, 1888.

<sup>2</sup> Laws of 1882-83, 29.

<sup>3</sup> Art. XII, sec. 2.

<sup>4</sup> *Ibid.*, sec. 9.

<sup>5</sup> *Ibid.*, sec. 10.

<sup>6</sup> Art. X, sec. 6. See Poore, 92-94.

<sup>7</sup> The university also received for several years the rent of the old State House at Tuscaloosa.

<sup>8</sup> U. S. Statutes at Large, I, 549. Poore, Charters and Constitutions, 1949.

<sup>9</sup> *Ibid.*, II, 69. Poore, Charters and Constitutions, 1051.

<sup>10</sup> Toullmin's Digest, 411. Digest of 1816, 310.

the lands south of Tennessee, Congress reserved a township of land for Jefferson College.<sup>1</sup> Federal assistance did not here, as was so often the case elsewhere, put a stop to local effort. In 1811 the Legislature granted for the use and benefit of the college the property of all intestates dying without heirs in the United States.<sup>2</sup> This act remained in force ten years. The State loaned the college six thousand dollars in 1816,<sup>3</sup> and four thousand dollars in 1820.<sup>4</sup>

The college is now extinct.

#### MISSISSIPPI COLLEGE.

In 1830 Mississippi Academy, in Hinds County, became Mississippi College.<sup>5</sup> A loan of five thousand dollars for a year and a half had been made by the State in 1829,<sup>6</sup> and in 1833 this was revived for five years.<sup>7</sup>

#### UNIVERSITY OF MISSISSIPPI.

In addition to the township of land granted to Jefferson College, Congress in 1819 gave another township for the support of a seminary of learning.<sup>8</sup> The lands were judiciously located and leased until 1833. In that year commissioners were appointed to sell them and invest the money in bank stock.<sup>9</sup> "Nearly all the proceeds of the Congressional land grant were lost on account of the wild and ruinous financial policy of the State which followed."<sup>10</sup> The whole matter is much confused.

The first legislative movement toward establishing the University of Mississippi was in 1840. It was then directed that a university should be established and that it should have the income of the seminary fund, as the fund arising from the land sales was called.<sup>11</sup> A site was selected, and in 1844 the university was incorporated. In 1846 it was granted fifty thousand dollars "out of any money in the treasury not otherwise appropriated."<sup>12</sup> Two years later the institution was formally opened.<sup>13</sup> The State treasurer was directed to pay the university \$6,226.75 a year, besides 6 per cent. interest on the amount then in the treasury.<sup>14</sup> In 1850 we find an annual appropriation of a "further sum" of six thousand dollars, one-half from the revenue in the treasury and one-half from further sales of seminary land.<sup>15</sup> On the establishment of a new professorship in 1854,<sup>16</sup> and on a similar occasion in 1860,<sup>17</sup> a salary of two thousand dollars a year was paid by the State. In his message of 1856 Governor McKee found the sum due from the State to the university to be \$1,077,700.07. The appropriations made from time to time, with

<sup>1</sup> U. S. Statutes at Large, II, 214.

<sup>2</sup> Digest of 1816, 264.

<sup>3</sup> *Ibid.*, 486.

<sup>4</sup> Laws of 1820, 53.

<sup>5</sup> Laws, second session of 1830, 101.

<sup>6</sup> Laws of 1829, 28.

<sup>7</sup> Laws, first session of 1833, 97.

<sup>8</sup> U. S. Statutes at Large, III, 485.

<sup>9</sup> Laws, first session of 1833, 173.

<sup>10</sup> Address by Chancellor Waddell.

<sup>11</sup> Laws of 1840, 96.

<sup>12</sup> Laws of 1846, 248.

<sup>13</sup> Chancellor Waddell's address.

<sup>14</sup> Laws of 1848, 104.

<sup>15</sup> Laws of 1850, 127.

<sup>16</sup> Laws of 1854, 160.

<sup>17</sup> Laws of 1860, 238.

their proper interest, being deducted, there was left \$874,324.49 as the actual amount due in 1856. A bill was introduced acknowledging this indebtedness, but the only result was an appropriation of twenty thousand dollars annually for five years, extended for two years longer in 1860.<sup>1</sup> In 1860 a commissioner was appointed to investigate the seminary fund and give the status of the account with the university,<sup>2</sup> but we find no record of his report.

After the War the twenty thousand dollar appropriation was renewed.<sup>3</sup> In the same year, 1867, commissioners were appointed to carry on a lottery; they were to pay five thousand dollars to the university before commencing business.<sup>4</sup> In 1871 fifty thousand dollars was granted annually for ten years.<sup>5</sup> The warrants of the State sold for but seventy-four per cent., however, and in 1875 this appropriation was replaced by one of thirty-five thousand dollars and one-half of the interest on the agricultural college land scrip.<sup>6</sup> Since then the appropriations have varied in amount. "In 1874 a careful calculation showed that the fund belonging to the university in the hands of the State amounted to over one million five hundred thousand dollars."<sup>7</sup> In 1880, "whereas the State of Mississippi did collect the proceeds arising from the sale of said lands and has never accounted for the same to the University of Mississippi," we find the Legislature engaging to pay interest on \$544,061.23 at six per cent. and appropriating \$32,643 annually as such interest.<sup>8</sup>

Up to 1888, the University of Mississippi has received from the State, exclusive of the land-scrip fund, nearly one million dollars. How much of this was appropriated as interest on the seminary fund and how much as direct gift it is impossible to determine.

#### AGRICULTURAL AND MECHANICAL COLLEGE.

The Constitution of 1868 directed that the Legislature should provide for the establishment of an agricultural college or colleges, and should take charge of the two hundred and ten thousand acres of land granted for that purpose.<sup>9</sup> The lands, which amounted to but 207,920 acres, yielded a net sum of \$227,500.<sup>10</sup> In 1873 it was directed that all moneys from the sale of land scrip should be used only for the construction of

<sup>1</sup> Chancellor Waddell's address. Laws of 1856, 76. Laws of 1859-60, 238.

<sup>2</sup> Laws of 1859-60, 391.

<sup>3</sup> Laws of 1862-67, 366.

<sup>4</sup> *Ibid.*, 452.

<sup>5</sup> Laws of 1871, 718.

<sup>6</sup> Annual catalogue for 1874. The State also gave, in scholarships, one hundred dollars to one student from each county.

<sup>7</sup> Chancellor Waddell's address.

<sup>8</sup> Laws of 1880, 152.

<sup>9</sup> Art. VIII, sec. 8, Poore, 1020. Report of U. S. Commissioner of Education for 1867, 130\*.

<sup>10</sup> Catalogue of Alcorn University for 1866-67.

the Vicksburg and Nashville Railroad.<sup>1</sup> This was virtually repealed by an act of 1876, which provided that this road should deposit in the treasury State bonds to the full amount of the land-scrip fund before any of the latter could be drawn out, and in case the road failed to comply within sixty days the fund was to remain in the treasury.<sup>2</sup> From 1875 to 1878 one-half of the interest on the fund went to the State university. In 1878 the fund was divided equally between the State Agricultural and Mechanical College at Starkville, for white students, and Alcorn University, for colored students.<sup>3</sup>

In addition to its share in this fund, \$5,678.75 annually, the college at Starkville has received from the State \$330,650.

**ALCORN UNIVERSITY.**

Alcorn University at Rodney was established in 1871, and given fifty thousand dollars a year for ten years.<sup>4</sup> In 1875 this was changed to fifteen thousand dollars and one-half of the interest on the land scrip fund.<sup>5</sup> Appropriations have since varied. The total amount set aside by the Legislature, exclusive of interest on the fund, is \$275,865. The share of this institution in the land scrip fund is \$113,575, invested at five per cent.<sup>6</sup>

## MISSISSIPPI INDUSTRIAL INSTITUTE.

This institution, "for the education of white girls of the State of Mississippi in the arts and sciences," was founded at Columbus in 1884, receiving an annual appropriation of twenty-thousand dollars.<sup>7</sup> The total amount received is \$107,857.50.

### CONSTITUTIONAL PROVISIONS.

The Constitution of 1832 declares that "schools and the means of education shall forever be encouraged in this State." Besides the provision regarding the Congressional land grant, the Constitution of 1868 orders the establishment of a uniform school system and directs that the Legislature shall, "as soon as practicable, establish schools of higher grade."

OFFICE OF THE ATTORNEY GENERAL, 100: 1-5.

[illegible]

## SUMMARY.

Public aid has been of great importance in Mississippi education. The beginning of three of the most important institutions of learning came from the Federal Government, but the State has taken these germs and developed them into a vigorous life. The following is a summary of the donations of the State:

|                                                                          |                |
|--------------------------------------------------------------------------|----------------|
| Agricultural and Mechanical College.....                                 | \$130,650.00   |
| Alcorn University.....                                                   | 275,865.00     |
| Mississippi Industrial Institute.....                                    | 107,857.50     |
|                                                                          | <hr/>          |
|                                                                          | \$714,372.50   |
| University of Mississippi, including income from seminary fund, about .. | \$1,000,000.00 |

## LOUISIANA.

## EARLY EDUCATION.

While Louisiana was yet under Territorial government the respective parishes were authorized in 1808<sup>1</sup> to establish elementary schools. The first State Constitution, adopted in 1812, made no mention of education, but the Legislature enacted laws providing for the establishment of parish schools. In 1814 the elementary parish schools were placed under the care and supervision of the police juries, and at the same time the sum of six hundred dollars annually was granted to each parish for the maintenance of said school or schools.<sup>2</sup>

This sum was increased to eight hundred dollars by an act of 1821, and finally fixed at \$1,350 by an act of 1827.<sup>3</sup>

But free schools were not established; these appropriations were made to institutions which were limited by a law to receive each only eight indigent pupils for instruction. Plans for a public school system had not yet been entertained.

The schools of the State in early times were usually meagre affairs. Although the State passed numerous acts for the assistance of schools and the endowments of academies and colleges, she did not make a decided attempt to establish a system of public education until 1845. The Constitution adopted at this time provided for free public schools throughout the State, for the protection of land grants, and for a State university.<sup>4</sup>

The public school system did not go into effect until 1847, and the university was established in 1855.

<sup>1</sup> Report of Commissioner of Education, 1867-68, 102.

<sup>2</sup> *Ibid.*, 1876, 146.

<sup>3</sup> E. H. Farrar: Address, 1880, 5.

<sup>4</sup> Title VII, Constitution, 1845.



## HIGHER EDUCATION.

A step toward higher education was made by the act of the Legislature of 1833, which provided for an academy in each parish, and appropriated fifty thousand dollars for their annual support. The Legislature likewise, at various times, incorporated and endowed numerous colleges and academies, most of which passed out of existence before they entered the realm of higher education.

Concerning these institutions Mr. Farrar says in an address before the University of Louisiana in 1880: "After considerable labor given to find out exactly the sums expended by the State in the endowment and maintenance of these organizations, I have found it next to impossible to obtain full and accurate data; however, it is safe to assert that the sums thus expended will reach *two millions of dollars*."<sup>1</sup>

Having enumerated many of the institutions thus created, Mr. Farrar says: "From the enumerations thus given it is obvious that if the interest taken by our people in public education should be measured by the liberality with which they have created and endowed institutions for that purpose, the measurement to be awarded them would be far from insignificant. But the important factor to be considered in this measurement is: What has become of these institutions? What is their history? What have we done towards elevating the standard of education in Louisiana? Melancholy, indeed, is the answer that comes to this questioning. With very few exceptions that answer is, 'They have perished, utterly.'" The exceptions are: Centenary College, Jefferson College, and the Louisiana State University and Agricultural and Mechanical College. "These three institutions are the sole living tenants of all those just mentioned." Since this address was made there has been a decided quickening of higher education in Louisiana. The State, as heretofore, is endeavoring to aid education, and with good effect.

## THE UNIVERSITY OF LOUISIANA (LITANE).

This institution had its origin in certain land grants made by the United States for the use of a "Seminary of Learning." By an act<sup>2</sup> of the General Government passed in 1806 one township of land was granted for the above named purpose, and in 1811 another township was added to this and both were confirmed by an act<sup>3</sup> of 1824 which also authorized their location.

<sup>1</sup> *Address*, p. 4.  
<sup>2</sup> *Statutes at Large*, Vol. II, p. 300, c. 11, § 394.  
<sup>3</sup> *Statutes at Large*, Vol. II, p. 300, c. 11, § 394.

<sup>4</sup> *Statutes at Large*, Vol. II, p. 300, c. 11, § 394.  
<sup>5</sup> *Statutes at Large*, Vol. II, p. 300, c. 11, § 394.

The first movement toward the utilization of these grants was made in 1845, when the following clause was adopted in the amended Constitution: "A university shall be established in the city of New Orleans. It shall be composed of four faculties, to wit: one of law, one of medicine, one of natural sciences, and one of letters."<sup>1</sup>

This title also enjoined upon the Legislature the duty of preservation of the land grants to keep them inviolate for the purposes therein mentioned.

The university was chartered in 1847, a complete organization being effected<sup>2</sup> and the new constitution of 1852 asserts that, "The University of Louisiana in New Orleans, as now established, shall be maintained."<sup>3</sup>

For many years the university received but meagre support from the State. The medical course was organized with the opening of the college and has "won an enviable reputation." An act of the Legislature approved March 28, 1850, appropriated twenty-five thousand dollars for the advancement of medical education in Louisiana, to be paid to the university in two installments, in July and December of the following year.<sup>4</sup> The law department also was continued with a degree of success, but the literary department was nothing "more than a grammar school, save and except the form of a collegiate organization kept up from 1851 to 1856." In 1855 the sum of \$13,500 was appropriated to complete a building for the law department.<sup>5</sup> The State prior to 1868 had given no aid to the university except a building for students, but in the revised Constitution of this date had stipulated to give "one half of the funds derived from the poll-tax \* \* \* to the support of the free public schools throughout the State and the University of New Orleans,"<sup>6</sup> and that "the General Assembly shall provide by law for its organization and maintenance."<sup>7</sup> By the Constitution of 1879 the institution was endowed permanently by authorizing the sum of not more than ten thousand dollars payable annually to the university.<sup>8</sup> At the expiration of this period the university was united with the Tulane University (in 1884). Since that time no appropriations have been made by the Legislature.

A list of the appropriations made by the State is kindly furnished me by the president, William P. Johnston, in a letter dated November 30, 1888.

<sup>1</sup> Constitution of Louisiana, 1845, Title VIII, Art. 137.

<sup>2</sup> Laws of 1847.

<sup>3</sup> Constitution of Louisiana, 1852, Title VIII, Art. 139.

<sup>4</sup> Laws of 1850, p. 189.

<sup>5</sup> Laws of 1855, p. 192, No. 137.

<sup>6</sup> Constitution of Louisiana, 1868, Title VIII, Art. 141.

<sup>7</sup> *Ibid.*, VII, Art. 142.

<sup>8</sup> *Ibid.*, 1879, Art. 227.

## 274 FEDERAL AND STATE AID TO HIGHER EDUCATION.

### APPROPRIATIONS TO TULANE UNIVERSITY OF LOUISIANA.

|                                                                                                                                         |          |
|-----------------------------------------------------------------------------------------------------------------------------------------|----------|
| One-half block in the city of New Orleans was granted to the university by the State for a site, which was valued at <sup>1</sup> ..... | \$15,000 |
| In 1847, acts of 1847, p. 105.....                                                                                                      | 25,000   |
| In 1850, acts of 1850, p. 189.....                                                                                                      | 25,000   |
| In 1853, acts of 1853, p. 173.....                                                                                                      | 6,000    |
| In 1855, acts of 1855, p. 192.....                                                                                                      | 13,500   |
| In 1857, acts of 1857, p. 106.....                                                                                                      | 12,500   |
| In 1860, acts of 1860, p. 254.....                                                                                                      | 25,000   |
| In 1867, acts of 1867, p. 335.....                                                                                                      | 3,000    |
| In 1871, acts of 1871, p. 50.....                                                                                                       | 6,500    |
| In 1879, Constitution, Art. 27, ten thousand dollars per annum for five years from date of act.....                                     | 50,000   |
| Total appropriation.....                                                                                                                | 155,500  |

### THE STATE UNIVERSITY AND AGRICULTURAL AND MECHANICAL COLLEGE.

This institution is located at Baton Rouge and must not be confounded with the University of Louisiana at New Orleans. The university at Baton Rouge originated in the union of the old State Seminary of Learning with the Agricultural and Mechanical College. Mr. Fay, in his History of Education in Louisiana, traces the history of Rapides Academy, which was incorporated in 1819 under the name of Rapides College, and shows that the State Seminary of Learning was the natural successor to the college. This school was among the first in the State to receive the benefits of the appropriations made to academies and seminaries. The Legislature in 1853 chartered the "State Seminary of Learning and Military Academy," and two years thereafter located and founded the institution on a site about three miles from Alexandria in the county of Rapides. The power of control of the seminary was vested in seven trustees appointed by the Governor with the approval of the Senate, who must render an annual report to the Legislature. Authority was given to the trustees by the Legislature to purchase for a site the "pine-woods seat," formerly belonging to Mrs. E. R. Williams, at a price not exceeding \$3,190.<sup>2</sup> It was enacted in 1855 that thirty thousand dollars be appropriated to assist in the construction of buildings, and the carrying out of the act of incorporation.<sup>3</sup> By the same act the trustees were authorized to purchase eighty acres additional for one thousand dollars. The school was not formally opened until January 2, 1860, when it was placed under the superintendency of Col. W. T. Sherman.

But scarcely were its doors opened before they were closed again on account of the Civil War. The seminary suspended June 30, 1861, and resumed its exercises April 1, 1862, continuing just twenty-two days,

<sup>1</sup> Letter from President William P. Johnston, November 28, 1882.

<sup>2</sup> Laws of Louisiana, 1853, p. 47, No. 72.

<sup>3</sup> *Ibid.*, 1855, p. 94, No. 96; p. 404, No. 317.

when it again suspended on account of the occupation of the country by the Federal troops.

The college was reopened October 2, 1865; for the necessary expenses of the reopening, the Governor borrowed in behalf of the institution the sum of twenty thousand dollars.

The Legislature acknowledged the indebtedness of the State to the seminary of the interest on the permanent fund of one hundred and thirty-six thousand dollars for the years 1863, 1864, and 1865, and authorized the payment of this to the amount of \$25,800. In addition to this special appropriations were made as follows: Five thousand dollars for repairs, five thousand dollars for apparatus, one thousand dollars for current expenses, and \$15,600 for the maintenance of fifty-two cadets, or three hundred dollars each, to as many as should attend, not exceeding fifty-two.<sup>1</sup>

In 1866-67 the number of beneficiary cadets was fixed equal to the number of representatives in the Legislature from each parish, and the amount paid to each student was four hundred dollars. The Legislature appropriated over thirty-six thousand dollars to meet the expenses of these cadets, besides giving ten thousand dollars for special purposes.

In 1867-68 the Legislature provided for the support of ninety cadets at the above rates, thirty-six thousand dollars, and the following session appropriated twenty-five thousand dollars for buildings and improvements.

In 1870 there was appropriated the sum of twenty thousand dollars to the seminary, and allowed \$35,700 for the support of cadets. In 1871 there was appropriated twenty thousand dollars to the university<sup>2</sup> at large, ten thousand dollars for apparatus, and \$46,200 allowed for the support of cadets.

It seems that the Legislature failed to make the usual appropriations for the support of the university for several years subsequent to 1871 and consequently the life of the institution was at a low ebb.

#### FOUNDING OF THE AGRICULTURAL AND MECHANICAL COLLEGE.

The Agricultural and Mechanical College was founded in 1874, and its union with the university in 1876 brought new life to this institution. The agricultural college was opened temporarily at New Orleans, but retained its separate existence for only three years, to the date of its organic union with the university at Baton Rouge.

The new university was organized in 1877 and reorganized in 1880. It was placed under control of twelve supervisors appointed by the Governor, in addition to three *ex officio* members, viz, the president of

<sup>1</sup> Fay: History of Education in Louisiana; part of the facts on this subject have been taken from Mr. Fay's manuscript, which was kindly lent the writer.

<sup>2</sup> The name of the seminary was changed in 1871 to that of university.

the faculty, the Superintendent of Public Instruction and the Governor of the State.

The proceeds of two hundred and ten thousand acres of land donated to the State by Congress yielded a net return of \$182,313.03 in United States currency.<sup>1</sup> This was invested in State bonds, making a fund of three hundred and twenty-seven thousand dollars, drawing six per cent. interest. Two years later (1875) these bonds were converted by constitutional amendment into new consolidated State bonds to the amount of \$796,200, bearing seven per cent. interest.<sup>2</sup> Again in 1879, this investment was converted by constitutional enactments into a simple obligation, and the original sum (\$182,313.03) was entered upon the auditor's book to the credit of the university at an interest of five per cent. The bonds were destroyed.

The first investment yielded an income of \$19,620, the second \$13,734, and the last \$9,115.65, the present income.<sup>3</sup>

Since the organization of the new institution known as the State University and Agricultural and Mechanical College, it receives its support from three sources, viz, from four per cent. on one hundred and thirty six thousand dollars, the seminary fund;<sup>4</sup> five per cent. on \$182,313, the agricultural college fund, and the annual appropriation of ten thousand dollars per annum<sup>5</sup> out of the public treasury since 1879.<sup>6</sup>

The income from these sources amounted in 1881-82 to \$24,556, and in 1886-87 to the same. The appropriation of the Legislature for 1889 is ten thousand dollars, and for 1890 the same; provided that two thousand dollars of each appropriation be used for necessary building repairs. In addition to the above amount the sum of four hundred and fifty dollars is appropriated for insurance.

#### SOUTHERN UNIVERSITY.

This school was organized by the Legislature in 1880 for the education of the colored race. At its foundation the Legislature granted an annual appropriation of ten thousand dollars for its support.

The school has grown with wonderful rapidity, and is a monument of the good will of the State toward the education of all citizens. The Legislature in 1888 increased the appropriation for the years 1889 and 1890 to seven or five thousand dollars each.<sup>7</sup>

#### SUMMARY OF APPROPRIATIONS.

It is quite impossible to make an estimate of the sums spent in Louisiana by the State for higher education. But we can at least estimate the income of recognized State institutions.

<sup>1</sup> Report of the Board of Supervisors, p. 36.

<sup>2</sup> Report of the Commissioner of Education, 1881, p. 80.

<sup>3</sup> *Ibid.*, Report, 1887, p. 36.

<sup>4</sup> Acts of the Assembly, 1880, No. 46.

<sup>5</sup> *Ibid.*

<sup>6</sup> *Ibid.*

<sup>7</sup> Acts of the Assembly.

|                                                                |                |
|----------------------------------------------------------------|----------------|
| Tulane University .....                                        | \$155,500      |
| State Seminary of Learning and Military Academy .....          | 299,090        |
| State University and Agricultural and Mechanical College ..... | 190,000        |
| Southern University .....                                      | 220,000        |
| <b>Total appropriations .....</b>                              | <b>794,590</b> |

Col. William P. Johnston estimates the amount received by the Agricultural and Mechanical College at Baton Rouge to be over one million dollars; this probably includes the incomes on the Congressional donation. In a memorial made to the General Assembly in 1860 by the Governor of Louisiana it is stated that more than three million dollars had been spent on colleges and academies. As before stated, Mr. Farrar, in an address delivered June 30, 1880, estimated that over two million dollars had been spent in this way. It is very difficult to arrive at any exact statement concerning the amount spent for higher education, for indeed the academies and some of those called colleges would be classified under the head of secondary instruction.

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TEXAS.

The peculiar conditions attached to the admission of Texas into the Union enabled her to retain the title to her public lands, and thus to have entire control of all reservations for public education. However, the method pursued here did not differ materially from that pursued by other States under the ordinance and policy of 1787.

In the year 1839, while Texas was yet an independent republic, the Legislature enacted <sup>1</sup> that there should be granted to each county then organized three leagues of land <sup>2</sup> for the purpose of establishing a primary school or academy. These lands were to be located in the county receiving the benefit of the grant if such suitable land could be there obtained, otherwise they were to be located in any of the public lands of the State and were to be located and surveyed at the public expense. The lands were to be surveyed in tracts of not less than one hundred and sixty acres each. In the following year the grant was enlarged to four leagues for each county and in 1850 the act <sup>3</sup> was made general for all newly organized counties.

The chief justice and two associate justices of each county were made *ex officio* school commissioners to adjust and apply the land grant to the support of the schools herebefore mentioned.<sup>4</sup>

This peculiar method of forming a school board out of the judiciary

<sup>1</sup> Laws of 1839, p. 120.

<sup>2</sup> The square league was the unit of land measure used by Spain, in all the Spanish American provinces.

<sup>3</sup> Laws of 1850.

<sup>4</sup> Laws of 1840, p. 146.

arose from the Spanish system of *alcaldes* who, as judges, had various other duties of administration attached. By this plan the better organized counties had schools at an early date, but it was not until 1834 that a law<sup>1</sup> was enacted to institute a system of free schools throughout the State. But the provision of the State was entirely inadequate for the maintenance of the schools formed, about four-fifths of their support being derived from tuition.<sup>2</sup> This plan was followed until the inception of the Civil War, when the entire disorganization followed.

#### CONSTITUTIONAL PROVISIONS.

The school system formed in 1834 was based upon the provisions of the Constitution of 1845, which declares that "a general diffusion of knowledge being essential to the preservation of the rights and liberties of the people, it shall be the duty of the Legislature of this State to make suitable provision for the support and maintenance of public schools."<sup>3</sup>

"The Legislature shall as soon as practicable establish free schools throughout the State and shall furnish means for their support by taxation on property; and it shall be the duty of the Legislature to set apart not less than one-tenth of the annual revenue of the State derived from taxation as a perpetual fund, which perpetual fund shall be appropriated for the support of free public schools."<sup>4</sup>

The Constitution of 1836 was silent on the subject of education, but that of 1866 and the amendment of 1869 repeated in general the sentiments of that of 1845; but it was not until 1876 that specific provisions were made for the support of higher education. These provisions we will speak of under the subject of

#### THE UNIVERSITY OF TEXAS.

The laws of 1839, granting public lands for the support of free schools also granted that three leagues of land should be set apart for the establishment and endowment of two colleges or universities.<sup>5</sup> However, nothing was done toward the establishment of a university until 1858, when a law was passed for the organization of said institution. The next legislation on the subject occurred after the interval had elapsed, set apart by the course of human events for the adjustment of political difficulties. This legislation, embodied in the Constitution of 1866, decreed that the land set apart for the endowment of universities shall be preserved, and authorized such legal provisions by the Legislature "as will organize and put into operation the university."<sup>6</sup>

<sup>1</sup> Laws of 1834.

<sup>2</sup> Report of Commissioner of Education, 1876, p. 384.

<sup>3</sup> Constitution of 1845, Art. X, sec. 1.

<sup>4</sup> Constitution of 1845, Art. X, sec. 2.

<sup>5</sup> Laws of 1839.

<sup>6</sup> Constitution of 1866, Art. X, sec. 6.

## PUBLIC LANDS.

In addition to the three leagues of land granted in 1839, every tenth section of lands granted or that might be granted to railroad companies or to the Galveston and Brazos Navigation Company was reserved for the benefit of the university.

It is estimated that this grant would have reached the magnificent proportions of one million six hundred thousand acres, "situated in the most thickly settled parts of the State, and worth, perhaps, on an average five dollars per acre."<sup>1</sup> Unfortunately for the university the grant of the tenth sections was withdrawn by the Constitution of 1876, and in lieu thereof one million acres of the unappropriated public domain were ordered set apart and appropriated for the endowment, maintenance, and support of the university.<sup>2</sup>

By an act of April 10, 1883, another million acres of land was set apart out of that portion of the public land devoted to the payment of the public debt to constitute a part of the permanent endowment fund of the University of Texas.

Out of the original grant of three leagues "there have been sold and patented 147,238 acres; sold and unpatented, 67,416 acres; in conflict, 21,762.5 acres."<sup>3</sup>

There were located of the tenth-section grants of the Galveston and Brazos Navigation Company nine and four-tenths sections, situated mainly in the eastern portions of the State and bringing no revenue at present.<sup>4</sup>

Of the first million-acre grant of 1876 only 71,040 acres are leased: these bring a revenue of \$3,524.96, the remaining 928,960 acres being wholly unproductive. The second million-acre grant remains entire, none of it having been either sold or leased.

The total remaining grant of 1,928,960 acres is nearly all grazing land.

From the regents' report of 1886 it seems that the present income of the university from its magnificent landed endowment is only \$47,552.51, part of which is from matriculation fees, amounting in 1887 to about \$3,200.<sup>5</sup>

From the same report we glean the following items which are presented here in order to show the method pursued by the Legislature in the treatment of the university grant.

First, the Legislature appropriated the fund for the uses of the State to the amount of \$145,761.90, as follows:<sup>6</sup>

|                            |       |              |
|----------------------------|-------|--------------|
| By act of January 31, 1860 | ..... | \$169,472.36 |
| By act of January 25, 1861 | ..... | 2,565.62     |
| By act of February 8, 1861 | ..... | 25,000.00    |
| By act of January 9, 1862  | ..... | 1,529.11     |

<sup>1</sup> Regents' Report, 1886, p. 7.

Regents' Report, p. 6.

<sup>2</sup> Constitution, 1876.

<sup>3</sup> Comptroller's Report, 1887, p. 7.

<sup>4</sup> Regents' Report, 1886, p. 8.

<sup>5</sup> Regent's Report, p. 62; letter from Comptroller.

<sup>6</sup> *Ibid.*



In each case there was a promise to pay the university the amount borrowed as soon as there were sufficient funds in the treasury to warrant it.

These funds have all been returned except in the cases of the second and fourth loans, amounting to \$11,289.02, which have not yet been repaid (1886). There was in connection with this the sum of \$12,230.39 of State warrants received in payment of university lands, which appears to have been dropped from the books in one of the acts of the constitutional convention of 1866, securing the school fund and university fund, and which has not yet been restored by the State to the University.

By the Constitution of 1876 the Agricultural and Mechanical College of Texas, established by an act of the Legislature of April 19, 1871, was made a part of the University of Texas. The Legislature has recognized this by appropriating from the university fund, for its support, an act not in accordance with the intent of the Federal and State Governments in making the grants for the support of the two institutions. From July 9, 1879, to April 1, 1885, in four separate acts, fifty thousand dollars were granted to the Agricultural and Mechanical College at Bryan. In regard to this it is set forth by the regents that "the college at Bryan is entitled to say that it is the technical branch of the University of Austin, but the University of Austin is not entitled to say that it has a technical branch at Bryan," for the reason that the branch at Bryan is not under the control of the regents of the university.

It is also to be noted that the Legislature appropriated at different times in the years 1879 and 1881 the aggregate sum of \$27,600 for the support of the Prairie View Normal School, established for the professional instruction of colored teachers, but for some cause only \$14,495.73 has been disbursed.

As this normal school, though a State institution, has never been recognized as having any relation whatsoever to the University, it would seem that the Legislature has gone far from justice and fallen short of duty in this respect.

Nevertheless, in the face of the above misdirections, there is no reason to fear that the State will not eventually make full and complete restoration of all misappropriated funds.

#### THE AGRICULTURAL AND MECHANICAL COLLEGE.

Texas received from the Congressional grant of 1862, 180,000 acres of land, some of which were formally accepted by the State in 1866. The land was sold in 1871 at eighty-seven cents per acre, yielding net proceeds of one hundred and fifty-six thousand dollars, which were invested in one-cent and gold frontier defence bonds of the State, issued under act of August 10, 1870, and thus making a permanent fund of one hundred and seventy-four thousand dollars.<sup>1</sup>

<sup>1</sup> Report of Regents, 1885, p. 1.

<sup>2</sup> Catalogue, 1885, p. 67.

There had accrued as interest on these bonds, in 1876, the sum of about thirty-five thousand dollars, which increased the permanent fund to the amount of two hundred and nine thousand dollars.<sup>1</sup>

The Legislature very promptly fulfilled its obligation by authorizing the establishment of the college by an act approved April 17, 1871, and by making liberal successive appropriations for building purposes, aggregating one hundred and eighty-seven thousand dollars, extending over the years 1871-76.<sup>2</sup> The county of Brazos, in order to secure the location of the college within its limits, donated the present agricultural farm of 2,416 acres, situated five miles from the town of Bryan.

An act approved March 9, 1875, and amended March 30, 1881, is the law for the present government of the college. It is controlled by a board of five directors appointed by the Governor of the State, said directors to be selected from different parts of the State and to hold office for six years. The government of the college is vested in this board, which has power to make rules and regulations for the same.

In 1876 the Constitution adopted at that time made the college a "branch of the University of Texas for the instruction in agriculture, the mechanic arts, and the natural sciences connected therewith."<sup>3</sup> And three years later the State librarian was authorized to turn over all books, minerals, and other geological specimens to the Agricultural and Mechanical College of Texas.

At the time of the organization of the college in 1876 there was but little sentiment in the Southern States against the exclusive study of the classics at the expense of the sciences and mechanic arts, and it is, therefore, not surprising to learn that the college opened as a classical and mathematical school for academic instruction rather than a technical school for the purpose of special training. While not neglecting the instruction in agriculture and the mechanic arts and studies adjunct to these, the classical instruction and general culture of the institution received the most attention. In this the institution but supplied the demands of the citizens of the State, and was not contrary to the general act of the Federal Government making the grant and establishing the conditions upon which such schools should be founded. But totally unprepared for teaching sciences and agriculture, the multitude of students who flocked to the school, did not receive what they came for; dissatisfaction arose, and the school proved so nearly a failure that it was necessary to call a meeting of the directors in November, 1879, when the school was reorganized. The Latin and Greek courses were consolidated and made subordinate and optional while the courses in science and agriculture were made more prominent.

It is to be noted that the attempt to maintain a system of manual labor on the farm failed here as elsewhere in the majority of cases

Comptroller's Report, 1887, p. 6.

Annual Catalogue, 1887, p. 7.

Constitution, 1876, Art. VII, sec. 13.

In each case there was a promise to pay the university the amount borrowed as soon as there were sufficient funds in the treasury to warrant it.

These funds have all been returned except in the cases of the second and fourth loans, amounting to \$11,280.02, which have not yet been repaid (1886). There was in connection with this the sum of \$12,230.39 of State warrants received in payment of university lands, which appears to have been dropped from the books in one of the acts of the constitutional convention of 1866, securing the school fund and university fund, and which has not yet been restored by the State to the University.

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<sup>2</sup> Annual Catalogue, 1887, p. 7.

<sup>3</sup> Constitution, 1876, Art. VII, sec. 13.

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where it has been tried. It was not until 1882 that the agricultural and mechanical departments were put into full operation.

There has been a flourishing military department from the beginning.

In 1888 the board of directors, in accordance with the act of Congress of 1887, established an experiment station in connection with and under the control of the authorities of the college.

### SUMMARY OF GRANTS.

The State has made the following liberal appropriations for the support of the school:

|                                         |             |
|-----------------------------------------|-------------|
| 1871, for building, etc.                | \$75,000.00 |
| 1874, for building, etc.                | 40,000.00   |
| 1875, for building, etc.                | 32,000.00   |
| 1876, for building, etc.                | 40,000.00   |
| 1879, for library and apparatus         | 15,000.00   |
| 1881, for improvements                  | 4,987.44    |
| 1881-82, State students                 | 15,000.00   |
| 1883-84, State students                 | 6,000.00    |
| 1883-84, expense of land out            | 8,000.00    |
| 1883-84, repairs, improvements, etc.    | 40,000.00   |
| 1885-86, maintenance and support        | 30,000.00   |
| 1887-88, maintenance and support        | 35,000.00   |
| 1888, for repairs and further equipment | 41,500.00   |
| Total State appropriation               | 382,487.44  |

The State misappropriated from the university fund as follows:

|                  |          |
|------------------|----------|
| Act July 9, 1879 | \$15,000 |
| Act Aug. 1, 1881 | 15,000   |
| Act Aug. 2, 1883 | 10,000   |
| Act Aug. 1, 1885 | 10,000   |
| Total            | 50,000   |

The productive fund of the institution is two hundred and nine thousand dollars, yielding an annual income of \$14,280, one hundred and seventy-four thousand dollars being invested in seven per cent. State bonds and thirty-five thousand dollars in six per cent. State bonds.

The value of the lands and buildings amounts to \$228,972. The productive fund amounted in 1886-87 to two hundred and nine thousand dollars which yielded an income of \$14,280.

## ARKANSAS

### THE SEMINARY GRANT.

By an act of March 2, 1827, Congress set aside two townships of land for the use and support of a seminary of learning in the Territory of Arkansas. The Assembly in 1833 made it the duty of the Territorial

<sup>1</sup> *Ark. Digest*, 1887, p. 678.

<sup>2</sup> Letter from the president, Louis M. McInnis, December 4, 1888.

<sup>3</sup> U. S. Statutes at Large, IV, p. 235; see, also, p. 661.

treasurer to loan out on good security the proceeds arising from the sales of seminary lands.<sup>1</sup> Five years later, the Governor was authorized to dispose of all such lands, but the price must be at least ten dollars an acre. The proceeds were to be deposited in the Bank of the State of Arkansas, to the credit of the university funds.<sup>2</sup> Some difficulty seems to have been found in obtaining so much for the lands, as we find the next Legislature reducing the minimum price to six dollars an acre.<sup>3</sup>

As a distinct fund, the seminary fund disappears in 1849, when it was divided among the counties for common school purposes. Only the interest could be used; the principal was to remain inviolate.<sup>4</sup>

#### ARKANSAS INDUSTRIAL UNIVERSITY.

By the act of Congress granting land for agricultural colleges, Arkansas received one hundred and fifty thousand acres. This was accepted in 1867.<sup>5</sup> In the following year the land scrip was given to Arkansas Industrial University, which was to be located in the town that held out to it the greatest inducements.<sup>6</sup> Fayetteville was chosen as the site, and the university opened in 1872.

The assistance of the State has been liberal. So far there has been appropriated \$257,894.33, of which sixty thousand dollars was given in 1887.

#### CONSTITUTIONAL PROVISIONS.

The Constitution of 1836 provided that education should be encouraged, and this was retained in the Constitution of 1865.<sup>7</sup>

In article IX, section 3, of the Constitution of 1868, we read: "The General Assembly shall establish and maintain a State university, with departments for instruction in teaching, agriculture, and the natural sciences, as soon as the public school fund will permit."<sup>8</sup> Section 4 guarantees the inviolability of educational funds, as does also article XIV, section 2, of the Constitution of 1874.

#### SUMMARY.

In the earlier period the attention of Arkansas was confined to primary education, but since the establishment of the industrial university, advanced instruction has been regarded. For this purpose the State has appropriated \$257,894.33.

<sup>1</sup> Laws of 1833, 13.

<sup>2</sup> Laws of 1838, 11.

<sup>3</sup> Laws of 1843, 17.

<sup>4</sup> Laws of 1849, 1, 2.

<sup>5</sup> Laws of 1867, 327.

<sup>6</sup> Laws of 1868, 327.

<sup>7</sup> Report of U. S. Commissioner of Education for 1867-68, 110.

<sup>8</sup> *Ibid.*, 136. Poore, Charters and Constitutions, 116.



## CHAPTER VIII.

### STATE EDUCATION IN THE WESTERN STATES.

It has become a settled policy among the States of the West to adopt a system of public education that includes a university. While non-State schools are not discouraged by legislative authority, there is a tendency to regard a State university as a sacred trust, essential to the public schools and to be guarded with jealous care. There is also a marked tendency in several States to keep the university near to the people; to make of it a democratic institution. For example, the University of Nebraska is governed by a board of regents, six in number, elected by the people for a term of six years. The State of Colorado has wisely adopted the same method. This gives the people an opportunity to prevent the management of the university from falling into the hands of political manipulators. The University of Nebraska is an excellent example of an institution that has been preserved from the toils of politics. It seems to have been established and maintained in the interests of the people. It is rather suggestive of the fact that with an organization of the right kind there is no necessity that any State university should be contaminated through partisan influences.

After a review of the effects of the changeable course of legislative bodies in the disposal of the public school lands, it is very gratifying to turn to the Constitution of Nebraska and find it there enacted that no public lands reserved for school purposes shall be sold for less than seven dollars per acre. Nebraska and California are among the best examples of the profitable disposal of public school lands. A wise policy seems to have dominated the management of the United States grants, while the incomes arising from them have been continually supplemented by generous appropriations by the Legislatures.

It is also notable that the Legislatures of several States are inclined to remove as far as possible the uncertainty of legislation by granting permanent endowments to universities. In this respect they are following the commendable example of Michigan, which gives one-twentieth of a mill on each taxable dollar, and Wisconsin, which gives one-eighth of a mill on each taxable dollar, for the permanent support of their respective universities. Iowa gives a fixed endowment of twenty thousand dollars per annum; Nebraska gives three eighths of a mill on each taxable dollar for the maintenance of the university; California gives one-tenth of a mill tax for the same purpose; and Colorado gives three



fifths of a mill for the support of three institutions of higher education. These permanent incomes are supplemented by liberal appropriations for current expenses and for buildings.

In these comparatively new States, where provisions for higher education are made while they are yet Territories and with the advantages of the experience of other States in the management of universities and their endowments, there is abundant opportunity to test the principles and the practice of State education to their fullest extent.

## MISSOURI.

### CONSTITUTIONAL PROVISIONS.

The first Constitution of Missouri, adopted in 1820, upon the admission of that State into the Union, asserts that "The General Assembly shall take measures for the improvement of such lands as have been or hereafter may be granted by the United States to this State for the support of a seminary of learning; and that the funds accruing from such lands by rent or lease or in any other manner, or which may be obtained from any other source for the purposes aforesaid, shall be and remain a permanent fund to *support a university for the promotion of literature and of the arts and sciences.*"<sup>1</sup> This early obligation taken by the people of the State for the administration of the trust imposed by the General Government granting two townships of land to the State for the purpose of a seminary of learning was, as in many other cases on record, a long time in being fulfilled.

Nothing was done towards the organization of a college until the year 1839, when an act was passed "to provide for the institution and support of the State university and colleges."<sup>2</sup> The bill was very elaborate, authorizing the organization of a central university and a system of colleges and academies in different parts of the State designed to be general educators and supporters of the university. These colleges were to be under the visitatorial power of the curators of the university. This plan proved impracticable on account of its cumbersome nature and of the insufficiency of funds to carry out the scheme. In the same year an act was passed authorizing the selection of a site for a university within two miles of the county seat of one of the seven central counties in the State, namely: Cole, Cooper, Callaway, Boone, Howard, or Saline. It was further provided that the site should contain at least fifty acres of land.

### A UNIVERSITY FOUNDED.

The commission appointed by the Legislature to select the site accepted the offer of the citizens of Boone County, who pledged to give \$117,000 to the university provided that it be located at Columbia.

<sup>1</sup> Constitution 1820, Art. VI, sec. 2.

<sup>2</sup> The University of Missouri, Hough.

Prior to this act there had been established a school called Columbia College, which was merged into the university, and the college building afforded accommodations for the students until the first university building was finished. The governing body of the university is a board of curators appointed by the General Assembly.

At the second meeting of the board in 1839, the curators entered at once upon their duties of organizing the university and the erection of buildings.

#### TREATMENT OF THE SEMINARY LANDS.

The lands which constituted the Federal endowment of the university were of very good quality, mostly situated in Jackson County. The Legislature ordered the sale of these lands in 1831, fixing the minimum price at two dollars per acre.

The result of this management yielded only the small sum of seventy thousand dollars as a permanent fund. The proceeds were invested in the stock of the Bank of the State of Missouri, and there remained until the accumulated fund amounted to one hundred thousand dollars, in 1839. A president of the new institution was elected in 1840. For twenty five years following the University of Missouri existed as a college of liberal arts, during which time the State of Missouri gave no assistance for its support. The legislative body did not even make good the deficit occurring through mismanagement, nor did it pay the curators except from the university funds. It had for its record the waste of a beneficent grant which would have formed a magnificent endowment had it been properly managed.

The lands were chosen and located in the most fertile part of Missouri, many of them in Jackson County, near Independence, and many of them were located in and adjoining Kansas City. "These lands, which were sacrificed are placed upon the assessment roll to-day (1885) at a valuation of three million dollars, and as every man knows that landed property in the State is not assessed at more than two-thirds of its actual value, they are worth at this time \$4,500,000."<sup>1</sup> It will be remembered that these lands were held in trust by the State for the benefit of a seminary of learning. "The trust was not carried out in good faith; the lands were prematurely and improvidently sold at an insufficient price, and thus the university was deprived of a large endowment fund."<sup>2</sup>

But it must be noted that the sale of these lands was ordered by the Legislature nine years before the university was organized, and consequently there was no one to exercise especial care over the university lands except the Legislature. "We venture the opinion that if these lands had been held in trust for ten years and until after the incorporation of the university by legislative act and then sold they would have commanded at least from ten dollars to twenty dollars per acre, for they were the richest lands in the State and were judiciously located in one of her finest counties."<sup>3</sup>

<sup>1</sup> Report of Curators, 1884-85, 204.

<sup>2</sup> *Ibid.*

## REORGANIZATION OF THE UNIVERSITY.

The record of the State, after twenty years of silence, on the subject of the injudicious investments of the funds of a struggling college, was broken by the event of the Civil War. The college suspended its work from 1862 to 1865, and when it resumed it was upon a new basis—that of a university. The Constitution adopted in 1865 declared expressly that "The General Assembly shall also establish and maintain a State university, with departments for instruction in teaching, in agriculture, and in natural science, as soon as the public school funds will permit."<sup>1</sup> The condition of the university in 1866 was deplorable. The sole endowment consisted of one hundred and twenty-three thousand dollars of stock in the old Bank of the State of Missouri and its branch at Chillicothe, the investment of the proceeds of the Congressional grant.

This stock paid, occasionally, small dividends. The number of students in 1866 was one hundred and four, the total income \$7,292.98, while a floating debt of twenty thousand dollars harassed the new officers of the institution. A corps of six—a president, three professors, and two tutors—composed the teaching force.

It was evident that this was not the university called for by the Constitution.

Not a dollar had ever been appropriated by the State in any manner whatever toward the support of the university. But the spell was broken in 1866-67 when the Legislature, for the first time, showed a gleam of recognition of its responsibility to higher education by appropriating ten thousand dollars for repairs on buildings. At the same time one and three fourths per cent. of the State revenue, after deducting twenty five per cent. for the public school fund, was devoted to the support of the institution. By this act its annual income was increased from the amount of twelve thousand dollars to fourteen thousand dollars.

## THE AGRICULTURAL GRANT.

An attempt to dispose of the Congressional land grant led to an entire reorganization of the university. A committee was appointed on reorganization and enlargement. The normal department had already been organized in 1868, and the university in 1870 consisted of this department and the College of Liberal Arts before referred to.

In accepting the grant of three hundred and thirty thousand acres of land set apart, seventy-five per cent. of the proceeds was devoted to an Agricultural and Mechanical College, and twenty five per cent. to a School of Mines; the former was organized in 1870, the latter in 1871.

This was the beginning of the reorganization recommended by the committee which reported in 1870 and placed the university at the head of the public school system.

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<sup>1</sup> Constitution of 1865, Art. IX, Sec. 4.

The College of Law was organized in 1872, and in the year following the College of Medicine and the department of analytical and applied chemistry.

The agricultural college was located at Columbia, in Boone County, a farm of six hundred and forty acres and thirty thousand dollars being donated by that county for its location.<sup>1</sup>

Under the new organization the endowment funds increased from one hundred and twenty-three thousand dollars of unproductive bank stock in 1870 to two hundred and thirty-one thousand dollars productive funds in 1876, in addition to the income from the Congressional land grant, the State income, and the Rollins fund. The entire income in 1876 was \$63,443.69.

The State has since made appropriations at different times. According to the report of the curators in 1884-85 the whole amount of State appropriations from October 1, 1841, to December 31, 1882, a period of more than forty years, has been \$534,343. A comparison with other institutions in the same period shows the entire expenditure for the penitentiary to be \$2,381,052.72; for the insane asylums, \$2,071,273.21; deaf and dumb asylums, \$1,044,901.37; school for the blind, \$661,592.51.<sup>2</sup>

#### GIFTS AND APPROPRIATIONS.

|                                                                                                                  |           |
|------------------------------------------------------------------------------------------------------------------|-----------|
| Seminary fund from the original grant of two townships of land by Congress in 1820 investment <sup>3</sup> ..... | \$108,700 |
| Gifts from individuals, Boone County, in order to secure the location of the university (1869).....              | 117,500   |
| Gift of Phelps County to secure the location of the School of Mines (1871).....                                  | 130,545   |
| Gift of Boone County and Columbia to secure the location of the Agricultural College.....                        | 90,000    |
| The Rollin's gift, at present (1882).....                                                                        | 32,000    |

#### APPROPRIATIONS BY THE STATE.

Upon the reorganization of the university in 1872, the State issued bonds covering the amount of the fund derived from the agricultural grant of 1862, which, with interest on the same, was one hundred and forty-seven thousand dollars; and the indebtedness of the State bank, on account of the seminary funds held in trust. The entire amount of the bonds issued was one hundred and sixty-six thousand dollars. In addition to this the Legislature authorized that bonds be issued to the amount of thirty-five thousand dollars for the benefit of the School of Mines at Rolla; the proceeds to be used in the erection of buildings for that institution. From this time on the State has been the

<sup>1</sup> Report of Curators, 1884-85, 200.

<sup>2</sup> *Ibid.*, 297.

<sup>3</sup> History of the University of Missouri, Franklin B. Hough, 51.

In each case there was a promise to pay the university the amount borrowed as soon as there were sufficient funds in the treasury to warrant it.

These funds have all been returned except in the cases of the second and fourth loans, amounting to \$11,289.02, which have not yet been repaid (1886). There was in connection with this the sum of \$12,230.39 of State warrants received in payment of university lands, which appears to have been dropped from the books in one of the acts of the constitutional convention of 1866, securing the school fund and university fund, and which has not yet been restored by the State to the University.

By the Constitution of 1876 the Agricultural and Mechanical College of Texas, established by an act of the Legislature of April 19, 1871, was made a part of the University of Texas. The Legislature has recognized this by appropriating from the university fund, for its support, an act not in accordance with the intent of the Federal and State Governments in making the grants for the support of the two institutions. From July 9, 1879, to April 1, 1885, in four separate acts, fifty thousand dollars were granted to the Agricultural and Mechanical College at Bryan. In regard to this it is set forth by the regents that "the college at Bryan is entitled to say that it is the technical branch of the University of Austin, but the University of Austin is not entitled to say that it has a technical branch at Bryan,"<sup>1</sup> for the reason that the branch at Bryan is not under the control of the regents of the university.

It is also to be noted that the Legislature appropriated at different times in the years 1879 and 1881 the aggregate sum of \$27,600 for the support of the Prairie View Normal School, established for the professional instruction of colored teachers, but for some cause only \$14,495.73 has been disbursed.

As this normal school, though a State institution, has never been recognized as having any relation whatsoever to the University, it would seem that the Legislature has gone far from justice and fallen short of duty in this respect.

Nevertheless, in the face of the above misdirections, there is no reason to fear that the State will not eventually make full and complete restoration of all misappropriated funds.

#### THE AGRICULTURAL AND MECHANICAL COLLEGE.

Texas received from the Congressional grant of 1862, 180,000 acres in land scrip, which were formally accepted by the State in 1866. The scrip was sold in 1871 at eighty-seven cents per acre, yielding net proceeds of one hundred and fifty-six thousand dollars, which were invested in seven per cent. gold frontier defence bonds of the State, issued under act of August 5, 1870, and thus making a permanent fund of one hundred and seventy-four thousand dollars.<sup>2</sup>

<sup>1</sup> Report of Regents, 1886, p. 15.

<sup>2</sup> Catalogue, 1885, p. 66.

Following closely the decrees of the Constitution, the first Legislature passed an act<sup>1</sup> locating the University of Iowa at Iowa City, granting for its use the public buildings<sup>2</sup> of the city, together with ten acres of land upon which they were situated, and the two seminary townships. The act further provides for the appointment of fifteen trustees by the General Assembly for the control of the said university, and authorized the proceeds of funds arising from the sale of lands to be loaned on real estate security for a term of years not less than five. It was further enacted "that the said university shall never be under the exclusive control of any religious denomination whatever." These donations were made upon the express condition that the said university shall, at such a time as the revenue shall equal two thousand dollars per annum, instruct and prepare fifty students annually for the business of common school teaching.<sup>3</sup>

In January, 1849, two branches of the university were authorized, one at Fairfield and the other at Dubuque, each to be placed on an equal footing with that of Iowa City.<sup>4</sup>

At Fairfield a site was purchased containing twenty acres and a building partially erected at a cost of twenty-five hundred dollars. In 1850 a hurricane nearly destroyed the building, which, however, was replaced by the citizens of Fairfield.<sup>5</sup>

At the request of the board controlling the Fairfield branch all connection with the State was severed.

The board of trustees of the University of Iowa, at a meeting held February 21, 1850, recognized "The College of Physicians and Surgeons of the Upper Mississippi," formerly established at Davenport, as an association branch of the university. The Legislature, in 1851, confirmed the action of the board and made the College of Physicians and Surgeons a part of the university, and subsequently, in 1864, placed it under the control of the board of trustees of the University of Iowa. This connection was severed in 1857 by the provisions of the new Constitution.

#### OPENING OF THE UNIVERSITY.

The university was partially opened for the admission of students in March, 1855, and again in September of the same year, and for each succeeding year regularly.<sup>6</sup>

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<sup>1</sup> Report of Board of Regents, 1877, 8.

<sup>2</sup> The public buildings were not vacated by the removal of the State government to Monroe City, according to the authorized plan. It was not until 1856 that the seat of the government was fixed at Des Moines. The buildings were vacated the following year.

<sup>3</sup> Laws of Iowa.

<sup>4</sup> Regents' Report, 1877, 9.

<sup>5</sup> Report of Board of Regents, 1877, 10.

<sup>6</sup> The total amount spent by the trustees from 1840 to January 1, 1855, was \$1,044.88. Report of trustees, 1877, 10.



where it has been tried. It was not until 1882 that the agricultural and mechanical departments were put into full operation.

There has been a flourishing military department from the beginning.

In 1888 the board of directors, in accordance with the act of Congress of 1887, established an experiment station in connection with and under the control of the authorities of the college.

#### SUMMARY OF GRANTS.

The State has made the following liberal appropriations for the support of the school:

|                                                     |             |
|-----------------------------------------------------|-------------|
| 1871, for building, etc. <sup>1</sup> .....         | \$75,000.00 |
| 1874, for building, etc.....                        | 40,000.00   |
| 1875, for building, etc.....                        | 32,000.00   |
| 1876, for building, etc.....                        | 40,000.00   |
| 1879, for library and apparatus.....                | 15,000.00   |
| 1881, for improvements.....                         | 4,987.44    |
| 1881-82, State students.....                        | 15,000.00   |
| 1883-84, State students.....                        | 6,000.00    |
| 1883-84, expense of land suit.....                  | 8,000.00    |
| 1883-84, repairs, improvements, etc.....            | 40,000.00   |
| 1885-86, maintenance and support <sup>2</sup> ..... | 30,000.00   |
| 1887-89, maintenance and support.....               | 35,000.00   |
| 1888, for repairs and further equipment.....        | 41,500.00   |
| Total State appropriation.....                      | 382,487.44  |

The State misappropriated from the university fund as follows:

|                          |          |
|--------------------------|----------|
| Act, July 9, 1879.....   | \$15,000 |
| Act, April 1, 1881.....  | 15,000   |
| Act, April 23, 1883..... | 10,000   |
| Act, April 1, 1885.....  | 10,000   |
| Total.....               | 50,000   |

The productive fund of the institution is two hundred and nine thousand dollars, yielding an annual income of \$14,280, one hundred and seventy-four thousand dollars being invested in seven per cent. State bonds and thirty-five thousand dollars in six per cent. State bonds.

The value of the lands and buildings amounts to \$228,972. The productive fund amounted in 1886-87 to two hundred and nine thousand dollars, which yielded an income of \$14,280.

#### ARKANSAS.

##### THE SEMINARY GRANT.

By an act of March 2, 1827, Congress set aside two townships of land for the use and support of a seminary of learning in the Territory of Arkansas.<sup>3</sup> The Assembly in 1833 made it the duty of the Territorial

<sup>1</sup> Catalogue 1885, p. 28.

<sup>2</sup> Letter from the president, Louis M. McInnis, December 4, 1888.

<sup>3</sup> U. S. Statutes at Large, IV, p. 235; see, also, p. 661.

Following closely the decrees of the Constitution, the first Legislature passed an act<sup>1</sup> locating the University of Iowa at Iowa City, granting for its use the public buildings<sup>2</sup> of the city, together with ten acres of land upon which they were situated, and the two seminary townships. The act further provides for the appointment of fifteen trustees by the General Assembly for the control of the said university, and authorized the proceeds of funds arising from the sale of lands to be loaned on real estate security for a term of years not less than five. It was further enacted "that the said university shall never be under the exclusive control of any religious denomination whatever." These donations were made upon the express condition that the said university shall, at such a time as the revenue shall equal two thousand dollars per annum, instruct and prepare fifty students annually for the business of common school teaching.<sup>3</sup>

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<sup>3</sup> Laws of Iowa.

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<sup>5</sup> Report of Board of Regents, 1877, 10.

<sup>6</sup> The total amount spent by the trustees from 1840 to January 1, 1855, was \$1,044.88. Report of trustees, 1877, 10.



The Constitution adopted in 1857 contained several important measures relative to the management of the university. All branches were discontinued by the following section, viz: "The State university shall be established at one place without branches at any other place, and the university fund shall be applied to that institution and no other."<sup>1</sup> The branch at Dubuque had never been organized, the branch at Fairfield had already been separated, and the medical college was the only department affected by this wise measure. "No aid from the State or from the university fund was ever given in support of the branches."<sup>2</sup>

Immediately after the adoption of the Constitution of 1857, the General Assembly made a new law for the organization of the university, which contained essentially the same enactments as the former law, with an additional proviso for twenty-six free tuition scholarships issued to young men selected from the high schools of the State, with the stipulation on their part to teach in some school for a term equal to the time they had accepted the benefit of the scholarship.<sup>3</sup> Other legislation of an unimportant nature followed for the further organization of the university, but the board at its meeting in February, 1859, decided, on account of the conditions of the finances of the university, not to reopen it and to close the normal department at the end of the term. It was finally concluded, at a subsequent meeting, to continue the normal department, and to formally reopen the university in September, 1860. This latter date may be regarded as the beginning of the existence of the university.

#### STATE APPROPRIATIONS.

Although it took thirteen years of legislation to start the State University of Iowa, the State upon the whole has shown itself faithful to the trust, both in legislation and in appropriations for expenses. The first appropriation was made in 1858, three thousand dollars being devoted to the repairs on the old State capitol and ten thousand dollars for the erection of the new building. The second appropriation was made in 1860, and, though small, is noted for the fact that it was paid from the proceeds of the saline land grants. Five thousand dollars were devoted to the new building, and five thousand to the purchase of apparatus and for repairs on the old building. As students filled the university to overflowing, the General Assembly assisted by appropriating from time to time funds for building purposes, for repairs, and for general expenses. Some of the principal donations are as follows:<sup>4</sup>

<sup>1</sup> Constitution of 1857, Art. IX, sec. 11.

<sup>2</sup> Board of Trustees, 1877, p. 1.

<sup>3</sup> This law was repealed in December of the same year. The original law was passed March 11, 1858. Report of the Trustees, 1877, 12, 13.

<sup>4</sup> Report of the State University, 12 *et seq.*

|                                                                        |          |
|------------------------------------------------------------------------|----------|
| In 1864, for building purposes .....                                   | \$20,000 |
| In 1865, 680 acres of land by the citizens of Iowa City.               |          |
| Building material, donated by Iowa City, about .....                   | 3,000    |
| In 1866 by the General Assembly for buildings .....                    | 21,000   |
| In 1868 by the General Assembly for repairs, etc.....                  | 20,000   |
| In 1870 by the General Assembly for the support of the university..... | 25,000   |
| In 1872 by the General Assembly for salaries and support .....         | 52,300   |
| In 1874 by the General Assembly for aid and support .....              | 46,000   |
| In 1876 by the General Assembly for aid and support.....               | 47,457   |
| In 1884 for School of Science building and expenses <sup>1</sup> ..... | 64,500   |

It will be noticed that the appropriations grow larger and more regular as the institution develops and has various needs. It is the history of every State institution of the kind, that each year that brings increased usefulness brings also more wants for the succeeding year. The last appropriation by the Legislature for the biennial period ending June 30, 1890, amounts in the aggregate to fifty-two thousand dollars.<sup>2</sup> Twenty thousand dollars of this fund was given to supplement the income fund, and twelve thousand to supplement the endowment fund. Special appropriations only were made until 1878, after which time an annual appropriation of twenty thousand dollars was made to the university by the Legislature, until 1884, when the amount was increased to twenty-eight thousand dollars.<sup>3</sup> (endowment fund).

It will be seen by this that the State appropriation for the years 1888 to 1890 amounts to fifty-four thousand dollars annually.

The aggregate appropriations from the date of the foundation of the university amount to \$660,672.30.<sup>4</sup>

A few changes had taken place in the control of the university since its organization. Education was placed, in 1858, in charge of the Board of Education, but this board was abolished in 1864, and the office of Superintendent of Public Instruction restored. The General Assembly by this act assumed more direct control over education than previously.

From January 15, 1849, to December 25, 1858, the Governor had been *ex officio* member of the board. From February 25, 1847, until March 12, 1858, the Superintendent of Public Instruction had been *ex officio* president of the board of trustees. By the act of March 12, 1858, he was made *ex officio* a member of the board, which continued until December 25, 1858, at which time the office of Superintendent ceased to exist by virtue of the Board of Education. This latter body remained in force until 1864, when it was enacted that it should no longer exist and that the board of trustees should report directly to the Legislature. In 1870 the Superintendent became again *ex officio* a member of the board of trustees and so remained until the membership was abolished in 1872. It was restored again in 1876, however. The General Assembly insti-

<sup>1</sup>Laws of 1884, chap. 112, p. 114.

<sup>2</sup>Laws, 1888, chap. 132, p. 190.

<sup>3</sup>Letter from President Charles A. Schaeffer, December 9, 1888.

<sup>4</sup>President Schaeffer.

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## CHAPTER VIII.

### STATE EDUCATION IN THE WESTERN STATES.

It has become a settled policy among the States of the West to adopt a system of public education that includes a university. While non-State schools are not discouraged by legislative authority, there is a tendency to regard a State university as a sacred trust, essential to the public schools and to be guarded with jealous care. There is also a marked tendency in several States to keep the university near to the people; to make of it a democratic institution. For example, the University of Nebraska is governed by a board of regents, six in number, elected by the people for a term of six years. The State of Colorado has wisely adopted the same method. This gives the people an opportunity to prevent the management of the university from falling into the hands of political manipulators. The University of Nebraska is an excellent example of an institution that has been preserved from the toils of politics. It seems to have been established and maintained in the interests of the people. It is rather suggestive of the fact that with an organization of the right kind there is no necessity that any State university should be contaminated through partisan influences.

After a review of the effects of the changeable course of legislative bodies in the disposal of the public school lands, it is very gratifying to turn to the Constitution of Nebraska and find it there enacted that no public lands reserved for school purposes shall be sold for less than seven dollars per acre. Nebraska and California are among the best examples of the profitable disposal of public school lands. A wise policy seems to have dominated the management of the United States grants, while the incomes arising from them have been continually supplemented by generous appropriations by the Legislatures.

It is also notable that the Legislatures of several States are inclined to remove as far as possible the uncertainty of legislation by granting permanent endowments to universities. In this respect they are following the commendable example of Michigan, which gives one-twentieth of a mill on each taxable dollar, and Wisconsin, which gives one-eighth of a mill on each taxable dollar, for the permanent support of their respective universities. Iowa gives a fixed endowment of twenty thousand dollars per annum; Nebraska gives three eighths of a mill on each taxable dollar for the maintenance of the university; California gives one-tenth of a mill tax for the same purpose; and Colorado gives three-

fifths of a mill for the support of three institutions of higher education. These permanent incomes are supplemented by liberal appropriations for current expenses and for buildings.

In these comparatively new States, where provisions for higher education are made while they are yet Territories and with the advantages of the experience of other States in the management of universities and their endowments, there is abundant opportunity to test the principles and the practice of State education to their fullest extent.

## MISSOURI.

### CONSTITUTIONAL PROVISIONS.

The first Constitution of Missouri, adopted in 1820, upon the admission of that State into the Union, asserts that "The General Assembly shall take measures for the improvement of such lands as have been or hereafter may be granted by the United States to this State for the support of a seminary of learning; and that the funds accruing from such lands by rent or lease or in any other manner, or which may be obtained from any other source for the purposes aforesaid, shall be and remain a permanent fund to *support a university for the promotion of literature and of the arts and sciences.*"<sup>1</sup> This early obligation taken by the people of the State for the administration of the trust imposed by the General Government granting two townships of land to the State for the purpose of a seminary of learning was, as in many other cases on record, a long time in being fulfilled.

Nothing was done towards the organization of a college until the year 1839, when an act was passed "to provide for the institution and support of the State university and colleges."<sup>2</sup> The bill was very elaborate, authorizing the organization of a central university and a system of colleges and academies in different parts of the State designed to be general educators and supporters of the university. These colleges were to be under the visitatorial power of the curators of the university. This plan proved impracticable on account of its cumbrous nature and of the insufficiency of funds to carry out the scheme. In the same year an act was passed authorizing the selection of a site for a university within two miles of the county seat of one of the seven central counties in the State, namely: Cole, Cooper, Callaway, Boone, Howard, or Saline. It was further provided that the site should contain at least fifty acres of land.

### A UNIVERSITY FOUNDED.

The commission appointed by the Legislature to select the site accepted the offer of the citizens of Boone County, who pledged to give \$117,000 to the university provided that it be located at Columbia.

<sup>1</sup> Constitution, 1-20, Art. VI, sec. 2.

<sup>2</sup> The University of Missouri, Hough.

Prior to this act there had been established a school called Columbia College, which was merged into the university, and the college building afforded accommodations for the students until the first university building was finished. The governing body of the university is a board of curators appointed by the General Assembly.

At the second meeting of the board in 1839, the curators entered at once upon their duties of organizing the university and the erection of buildings.

#### TREATMENT OF THE SEMINARY LANDS.

The lands which constituted the Federal endowment of the university were of very good quality, mostly situated in Jackson County. The Legislature ordered the sale of these lands in 1831, fixing the minimum price at two dollars per acre.

The result of this management yielded only the small sum of seventy thousand dollars as a permanent fund. The proceeds were invested in the stock of the Bank of the State of Missouri, and there remained until the accumulated fund amounted to one hundred thousand dollars, in 1839. A president of the new institution was elected in 1840. For twenty five years following the University of Missouri existed as a college of liberal arts, during which time the State of Missouri gave no assistance for its support. The legislative body did not even make good the deficit occurring through mismanagement, nor did it pay the curators except from the university funds. It had for its record the waste of a beneficent grant which would have formed a magnificent endowment had it been properly managed.

The lands were chosen and located in the most fertile part of Missouri, many of them in Jackson County, near Independence, and many of them were located in and adjoining Kansas City. "These lands, which were sacrificed are placed upon the assessment roll to-day (1885) at a valuation of three million dollars, and as every man knows that landed property in the State is not assessed at more than two-thirds of its actual value, they are worth at this time \$4,500,000."<sup>1</sup> It will be remembered that these lands were held in trust by the State for the benefit of a seminary of learning. "The trust was not carried out in good faith; the lands were prematurely and improvidently sold at an insufficient price, and thus the university was deprived of a large endowment fund."<sup>2</sup>

But it must be noted that the sale of these lands was ordered by the Legislature nine years before the university was organized, and consequently there was no one to exercise especial care over the university lands except the Legislature. "We venture the opinion that if these lands had been held in trust for ten years and until after the incorporation of the university by legislative act and then sold they would have commanded at least from ten dollars to twenty dollars per acre, for they were the richest lands in the State and were judiciously located in one of her finest counties."<sup>2</sup>

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The record of the State, after twenty years of silence, on the subject of the injudicious investments of the funds of a struggling college, was broken by the event of the Civil War. The college suspended its work from 1862 to 1865, and when it resumed it was upon a new basis—that of a university. The Constitution adopted in 1865 declared expressly that "the General Assembly shall also establish and maintain a State university, with departments for instruction in teaching, in agriculture, and in natural science, as soon as the public school funds will permit."<sup>1</sup> The condition of the university in 1866 was deplorable. The sole endowment consisted of one hundred and twenty-three thousand dollars of stock in the old Bank of the State of Missouri and its branch at Chillicothe, the investment of the proceeds of the Congressional grant.

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Not a dollar had ever been appropriated by the State in any manner whatever toward the support of the university. But the spell was broken in 1866-67 when the Legislature, for the first time, showed a gleam of recognition of its responsibility to higher education by appropriating ten thousand dollars for repairs on buildings. At the same time one and three fourths per cent. of the State revenue, after deducting twenty five per cent. for the public school fund, was devoted to the support of the institution. By this act its annual income was increased from the amount of twelve thousand dollars to fourteen thousand dollars.

## THE AGRICULTURAL GRANT.

An attempt to dispose of the Congressional land grant led to an entire reorganization of the university. A committee was appointed on reorganization and enlargement. The normal department had already been organized in 1868, and the university in 1870 consisted of this department and the College of Liberal Arts before referred to.

In accepting the grant of three hundred and thirty thousand acres of land set apart seventy-five per cent. of the proceeds was devoted to an Agricultural and Mechanical College, and twenty five per cent. to a School of Mines; the former was organized in 1870, the latter in 1871.

This was the beginning of the reorganization recommended by the committee when reported in 1870 and placed the university at the head of the public school system.

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<sup>1</sup> Constitution of 1865, Art. IX, sec. 4.

The College of Law was organized in 1872, and in the year following the College of Medicine and the department of analytical and applied chemistry.

The agricultural college was located at Columbia, in Boone County, a farm of six hundred and forty acres and thirty thousand dollars being donated by that county for its location.<sup>1</sup>

Under the new organization the endowment funds increased from one hundred and twenty-three thousand dollars of unproductive bank stock in 1870 to two hundred and thirty-one thousand dollars productive funds in 1876, in addition to the income from the Congressional land grant, the State income, and the Rollins fund. The entire income in 1876 was \$63,443.69.

The State has since made appropriations at different times. According to the report of the curators in 1884-85 the whole amount of State appropriations from October 1, 1811, to December 31, 1882, a period of more than forty years, has been \$531,343. A comparison with other institutions in the same period shows the entire expenditure for the penitentiary to be \$2,381,052.72; for the insane asylums, \$2,071,273.21; deaf and dumb asylums, \$1,044,901.37; school for the blind, \$661,592.51.<sup>2</sup>

#### GIFTS AND APPROPRIATIONS.

|                                                                                                                  |           |
|------------------------------------------------------------------------------------------------------------------|-----------|
| Seminary fund from the original grant of two townships of land by Congress in 1820 investment <sup>3</sup> ..... | \$108,700 |
| Gifts from individuals, Boone County, in order to secure the location of the university (1839).....              | 117,500   |
| Gift of Phelps County to secure the location of the School of Mines (1871).....                                  | 130,545   |
| Gift of Boone County and Columbia to secure the location of the Agricultural College.....                        | 90,000    |
| The Rollin's gift, at present (1882).....                                                                        | 32,000    |

#### APPROPRIATIONS BY THE STATE.

Upon the reorganization of the university in 1872, the State issued bonds covering the amount of the fund derived from the agricultural grant of 1862, which, with interest on the same, was one hundred and forty-seven thousand dollars; and the indebtedness of the State bank, on account of the seminary funds held in trust. The entire amount of the bonds issued was one hundred and sixty-six thousand dollars. In addition to this the Legislature authorized that bonds be issued to the amount of thirty-five thousand dollars for the benefit of the School of Mines at Rolla; the proceeds to be used in the erection of buildings for that institution. From this time on the State has been the

<sup>1</sup> Report of Curators, 1884-85, 200.

<sup>2</sup> *Ibid.*, 29.

<sup>3</sup> History of the University of Missouri, Franklin B. Hough, 51.



The Constitution adopted in 1857 contained several important measures relative to the management of the university. All branches were discontinued by the following section, viz: "The State university shall be established at one place without branches at any other place, and the university fund shall be applied to that institution and no other."<sup>1</sup> The branch at Dubuque had never been organized, the branch at Fairfield had already been separated, and the medical college was the only department affected by this wise measure. "No aid from the State or from the university fund was ever given in support of the branches."<sup>2</sup>

Immediately after the adoption of the Constitution of 1857, the General Assembly made a new law for the organization of the university, which contained essentially the same enactments as the former law, with an additional proviso for twenty-six free tuition scholarships issued to young men selected from the high schools of the State, with the stipulation on their part to teach in some school for a term equal to the time they had accepted the benefit of the scholarship.<sup>3</sup> Other legislation of an unimportant nature followed for the further organization of the university, but the board at its meeting in February, 1859, decided, on account of the conditions of the finances of the university, not to reopen it and to close the normal department at the end of the term. It was finally concluded, at a subsequent meeting, to continue the normal department, and to formally reopen the university in September, 1860. This latter date may be regarded as the beginning of the existence of the university.

#### STATE APPROPRIATIONS.

Although it took thirteen years of legislation to start the State University of Iowa, the State upon the whole has shown itself faithful to the trust, both in legislation and in appropriations for expenses. The first appropriation was made in 1858, three thousand dollars being devoted to the repairs on the old State capitol and ten thousand dollars for the erection of the new building. The second appropriation was made in 1860, and, though small, is noted for the fact that it was paid from the proceeds of the saline land grants. Five thousand dollars were devoted to the new building, and five thousand to the purchase of apparatus and for repairs on the old building. As students filled the university to overflowing, the General Assembly assisted by appropriating from time to time funds for building purposes, for repairs, and for general expenses. Some of the principal donations are as follows:<sup>4</sup>

<sup>1</sup> Constitution, 1857. Art. IX, sec. 11.

<sup>2</sup> Board of Trustees, 1877, 9.

<sup>3</sup> This law was repealed in December of the same year. The original law was passed March 12, 1858. (Report of the Trustees, 1877, 12, 13.)

<sup>4</sup> Report of the State University, 12 *et seq.*

Following closely the decrees of the Constitution, the first Legislature passed an act<sup>1</sup> locating the University of Iowa at Iowa City, granting for its use the public buildings<sup>2</sup> of the city, together with ten acres of land upon which they were situated, and the two seminary townships. The act further provides for the appointment of fifteen trustees by the General Assembly for the control of the said university, and authorized the proceeds of funds arising from the sale of lands to be loaned on real estate security for a term of years not less than five. It was further enacted "that the said university shall never be under the exclusive control of any religious denomination whatever." These donations were made upon the express condition that the said university shall, at such a time as the revenue shall equal two thousand dollars per annum, instruct and prepare fifty students annually for the business of common school teaching.<sup>3</sup>

In January, 1849, two branches of the university were authorized, one at Fairfield and the other at Dubuque, each to be placed on an equal footing with that of Iowa City.<sup>4</sup>

At Fairfield a site was purchased containing twenty acres and a building partially erected at a cost of twenty-five hundred dollars. In 1850 a hurricane nearly destroyed the building, which, however, was replaced by the citizens of Fairfield.<sup>5</sup>

At the request of the board controlling the Fairfield branch all connection with the State was severed.

The board of trustees of the University of Iowa, at a meeting held February 21, 1850, recognized "The College of Physicians and Surgeons of the Upper Mississippi," formerly established at Davenport, as an association branch of the university. The Legislature, in 1851, confirmed the action of the board and made the College of Physicians and Surgeons a part of the university, and subsequently, in 1864, placed it under the control of the board of trustees of the University of Iowa. This connection was severed in 1857 by the provisions of the new Constitution.

#### OPENING OF THE UNIVERSITY.

The university was partially opened for the admission of students in March, 1855, and again in September of the same year, and for each succeeding year regularly.<sup>6</sup>

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<sup>1</sup> Report of Board of Regents, 1877, 8.

<sup>2</sup> The public buildings were not vacated by the removal of the State government to Monroe City, according to the authorized plan. It was not until 1856 that the seat of the government was fixed at Des Moines. The buildings were vacated the following year.

<sup>3</sup> Laws of Iowa.

<sup>4</sup> Regents' Report, 1877, 9.

<sup>5</sup> Report of Board of Regents, 1877, 10.

<sup>6</sup> The total amount spent by the trustees from 1840 to January 1, 1855, was \$1,044.88. Report of trustees, 1877, 10.

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<sup>1</sup> Constitution of 1857, Art. IX, sec. II.

<sup>2</sup> Board of Trustees, 1877, p. 3.

<sup>3</sup> This law was repealed in December of the same year. The original law was passed March 12, 1858. Report of the Trustees, 1877, 12, 13.

<sup>4</sup> Report of the State University, 12 *et seq.*

|                                                                        |          |
|------------------------------------------------------------------------|----------|
| In 1864, for building purposes .....                                   | \$20,000 |
| In 1865, 650 acres of land by the citizens of Iowa City.               |          |
| Building material, donated by Iowa City, about .....                   | 3,000    |
| In 1866 by the General Assembly for buildings .....                    | 21,000   |
| In 1868 by the General Assembly for repairs, etc.....                  | 20,000   |
| In 1870 by the General Assembly for the support of the university..... | 25,000   |
| In 1872 by the General Assembly for salaries and support .....         | 52,300   |
| In 1874 by the General Assembly for aid and support .....              | 46,000   |
| In 1876 by the General Assembly for aid and support.....               | 47,457   |
| In 1884 for School of Science building and expenses <sup>1</sup> ..... | 64,500   |

It will be noticed that the appropriations grow larger and more regular as the institution develops and has various needs. It is the history of every State institution of the kind, that each year that brings increased usefulness brings also more wants for the succeeding year. The last appropriation by the Legislature for the biennial period ending June 30, 1890, amounts in the aggregate to fifty-two thousand dollars.<sup>2</sup> Twenty thousand dollars of this fund was given to supplement the income fund, and twelve thousand to supplement the endowment fund. Special appropriations only were made until 1878, after which time an annual appropriation of twenty thousand dollars was made to the university by the Legislature, until 1884, when the amount was increased to twenty-eight thousand dollars<sup>3</sup> (endowment fund).

It will be seen by this that the State appropriation for the years 1888 to 1890 amounts to fifty-four thousand dollars annually.

The aggregate appropriations from the date of the foundation of the university amount to \$660,672.30.<sup>4</sup>

A few changes had taken place in the control of the university since its organization. Education was placed, in 1858, in charge of the Board of Education, but this board was abolished in 1864, and the office of Superintendent of Public Instruction restored. The General Assembly by this act assumed more direct control over education than previously.

From January 15, 1849, to December 25, 1858, the Governor had been *ex officio* member of the board. From February 25, 1847, until March 12, 1858, the Superintendent of Public Instruction had been *ex officio* president of the board of trustees. By the act of March 12, 1858, he was made *ex officio* a member of the board, which continued until December 25, 1858, at which time the office of Superintendent ceased to exist by virtue of the Board of Education. This latter body remained in force until 1864, when it was enacted that it should no longer exist and that the board of trustees should report directly to the Legislature. In 1870 the Superintendent became again *ex officio* a member of the board of trustees and so remained until the membership was abolished in 1872. It was restored again in 1876, however. The General Assembly insti-

<sup>1</sup>Laws of 1884, Chap. 112, p. 114.

<sup>2</sup>Laws, 1888, Chap. 132, p. 169.

<sup>3</sup>Letter from President Charles A. Schaeffer, December 9, 1888.

<sup>4</sup>President Schaeffer.

tuted, by an act passed in 1870, the board of regents as the governing power of the university.

The law school was organized in 1868, and the medical department in 1870.

#### SEMINARY LANDS.

As has been before shown, the Federal Government gave the State of Iowa two townships, more or less, amounting to 45,28.24 acres. Up to 1859 there had been sold of this land 31,400 acres at an average price of three dollars and fifty-two cents per acre. The lands were originally appraised at five dollars per acre and subsequently raised to ten dollars. Had they not been sold until the price of ten dollars per acre was reached the income would have been more than twice what it is to-day.<sup>1</sup> Sales were made subsequent to 1859, so that there now remains unsold 2,059.7 acres. The fund received from this source amounts to \$261,266.64, including sales from saline lands.<sup>1</sup> There were originally 46,100 acres in the saline grant; of these the university received less than 4,600 acres (4,578.43), with some saline land contracts, which amounted to but little. Of these lands there remain unsold over three thousand acres (1886). In the report above alluded to, we find the following statement referring to the endowment fund: "But for the hurried sales it would have been not less than five hundred thousand dollars, and with the entire saline grant it would have been not less than a million."<sup>2</sup>

#### THE STATE AGRICULTURAL COLLEGE.

In 1858 the Legislature of Iowa passed an act to establish a "State Agricultural College and Model Farm," to be connected with the entire agricultural interests of the State. A board of commissioners was appointed to buy a farm, erect a college building, select a faculty and organize a college.<sup>3</sup>

A farm of 640 acres was purchased in 1859 for the use of the college, and a purely agricultural institution was started.

In 1872 the State accepted the agricultural land grant of Congress, and the Agricultural College was enlarged so as to include studies in the mechanical arts. Ten years later the course was again broadened by authority of the Legislature. Section 2631 of the Iowa Code institutes: "That there shall be adopted and taught at the State Agricultural College a broad, liberal and practical course of study in which the leading branches of learning shall relate to agriculture and the mechanic arts, and which shall also embrace such other branches of learning as will most practically and liberally educate the agricultural and industrial classes in the several pursuits and professions of life, including military tactics."<sup>4</sup>

<sup>1</sup> Report of Officers of the State University, 1886, Iowa Doc. II, 7.

<sup>2</sup> Documents of Iowa, 1886, II, 7.

<sup>3</sup> Annual Catalogue, 1860, 21.

<sup>4</sup> Iowa Code.

## APPROPRIATIONS.

When the Agricultural College was incorporated, the Legislature appropriated ten thousand dollars for the purchase of a farm, and the county of Story donated the same amount in bonds bearing seven per cent. interest, while individuals gave seven thousand dollars additional in bonds and notes. The State also gave five sections of land in Jasper County, originally given by the Federal Government to the State for the building of a capitol. From this land the college realized fourteen thousand dollars; before the reception of the Congressional grant there was a fund of thirty thousand dollars besides the amount spent in purchasing a site and erection of a farm house. The Legislature also, in 1864, appropriated twenty thousand dollars, and two years thereafter ninety-one thousand dollars, for the purpose of a college building.<sup>1</sup>

The college received from the national grant two hundred and forty thousand acres of land; this land was partly sold and partly leased, and the fund derived from the same yields an average income of about forty-five thousand dollars, and the entire income is about sixty thousand dollars from productive sources.

The total State appropriation to June 30, 1887, is \$454,098.75.

## MINNESOTA.

## TERRITORIAL POLICY.

The importance of higher education was early recognized by the settlers of Minnesota. Two years after the organization of the Territory, the Legislature petitioned Congress for a grant of one hundred thousand acres of land to endow a university,<sup>2</sup> and on the very day of this petition two townships were set aside for that purpose.<sup>3</sup> The Legislature went on to enact that the University of Minnesota should be established at or near the Falls of St. Anthony and should have the income from all land thereafter granted by the United States for university purposes. Under this grant the regents selected a large portion of the lands and erected a costly edifice, but they were soon obliged to mortgage both building and lands in order to meet the obligations incurred.<sup>4</sup>

## ADMISSION OF THE STATE INTO THE UNION.

Affairs were in this condition when Congress passed the act admitting Minnesota to the Union, by which two townships of land were

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<sup>1</sup> Report of the Commissioner of Education, 1867, 27.

<sup>2</sup> Laws of 1851, 41.

<sup>3</sup> Act of February 19, 1851, U. S. Statutes at Large, IX, 568.

<sup>4</sup> Report of the Commissioner of Education for 1867, 6, 7, 75.

granted for the use and support of a State university.<sup>1</sup> There is no reference to the lands previously granted, such as we find in similar acts relating to other States. "Certainly it was not the intention of Congress to turn over the debts and prospectively encumbered lands of an old and badly managed Territorial institution, but to give the State that was to be, a grant for a State university, free from all connections with Territorial organizations."<sup>2</sup> The security of the institution was guaranteed by the Constitution of 1857, adopted in the year of the second land grant, which reads as follows: "The location of the University of Minnesota, as established by existing laws, is hereby confirmed, and said institution is hereby declared to be the University of the State of Minnesota. All the rights, immunities, franchises, and endowments heretofore granted or conferred are hereby perpetuated unto the said university, and all lands which may be granted hereafter by Congress, or other donations, for said university purposes, shall vest in the institution referred to in this section."<sup>3</sup>

Efforts were at once made to open the university, but the financial crisis of 1857 and the Civil War checked further action and encumbered the university with debt. In 1861 the Legislature appointed a special commission to dispose of a portion of the public lands, and by this means all debts were discharged.<sup>4</sup>

### PERMANENT ORGANIZATION OF THE UNIVERSITY.

The present organization of the university dates from 1868, when an act was passed "to reorganize the University of Minnesota and to establish an agricultural college therein."<sup>2</sup> In the following year college classes were first organized.<sup>3</sup> The act of 1868 provided that the university should have the income from the agricultural college grant,<sup>4</sup> which lands, as well as those before acquired, were to be sold, the proceeds to form a permanent university fund at the disposal of the regents.<sup>5</sup> The agricultural college lands were not to be sold for less than five dollars an acre, nor for less than their appraised value.<sup>6</sup> From the university lands that have been sold something over eight hundred

100

Report of the Congress on the Education for 1965, 66, 67, 70

Art. VIII. The Legislature shall have the power to provide for the support of the public schools. Art. IX.

1

[illegible]

1. The first group of respondents (n = 10) was composed of students who had completed the course and were currently employed in a position related to their field of study. These respondents were contacted via email and asked to participate in the study. The second group (n = 10) was composed of students who had completed the course and were currently employed in a position not related to their field of study. These respondents were contacted via email and asked to participate in the study. The third group (n = 10) was composed of students who had completed the course and were currently unemployed. These respondents were contacted via email and asked to participate in the study. The fourth group (n = 10) was composed of students who had completed the course and were currently employed in a position related to their field of study. These respondents were contacted via email and asked to participate in the study. The fifth group (n = 10) was composed of students who had completed the course and were currently employed in a position not related to their field of study. These respondents were contacted via email and asked to participate in the study. The sixth group (n = 10) was composed of students who had completed the course and were currently unemployed. These respondents were contacted via email and asked to participate in the study. The seventh group (n = 10) was composed of students who had completed the course and were currently employed in a position related to their field of study. These respondents were contacted via email and asked to participate in the study. The eighth group (n = 10) was composed of students who had completed the course and were currently employed in a position not related to their field of study. These respondents were contacted via email and asked to participate in the study. The ninth group (n = 10) was composed of students who had completed the course and were currently unemployed. These respondents were contacted via email and asked to participate in the study. The tenth group (n = 10) was composed of students who had completed the course and were currently employed in a position related to their field of study. These respondents were contacted via email and asked to participate in the study.

1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 26

the 1950s, the 1960s, and the 1970s had been set apart in 1865 for African Americans. The 1950s and 1960s had been reserved for African Americans, and the 1970s had been reserved for African Americans. In 1865, the 13th Amendment to the U.S. Constitution was passed, which abolished slavery. The 14th Amendment, passed in 1868, granted citizenship to all persons born or naturalized in the United States. The 15th Amendment, passed in 1870, prohibited the federal government and the states from denying a male citizen the right to vote based on race, color, or previous condition of servitude. The 1950s and 1960s were marked by the Civil Rights Movement, which fought for the rights of African Americans. The 1970s were marked by the Vietnam War and the Watergate scandal.

1. *Chrysomelidae* - 15

thousand dollars has been received, from which there is an annual income of about thirty-seven thousand dollars.<sup>1</sup>

#### EDUCATIONAL POLICY OF MINNESOTA.

Minnesota's policy has been persistently in favor of State education. While Congress was unusually liberal in the seminary grant, the direct assistance of the State has been great. Up to July 31, 1888, five hundred and eighty-three thousand dollars had been appropriated, exclusive of interest or permanent funds. The direct annual appropriation is now forty thousand dollars.

#### KANSAS.

##### THE UNIVERSITY OF LAWRENCE.

An institution of learning bearing the name "The University of Lawrence," was opened in Lawrence, Kans., April 11, 1859, under the auspices of the Presbyterian Church, but financial embarrassment compelled its early suspension and led to a new organization under the control of the Protestant Episcopal Church known as "The Lawrence University of Kansas," for which a charter was received from the Legislature in 1861.<sup>2</sup> These two educational institutions—the former perhaps the earliest educational enterprise in the State—have a fitting place in this study because of their close historical connection with the University of Kansas. This connection is established by an ordinance of the city of Lawrence securing to the State forty acres of land for a campus and all rights and interests in the Lawrence University.<sup>3</sup> The old Presbyterian institution, so short-lived, left to its successor the mere foundation of a building, upon which the latter, by the aid of a donation of twenty thousand dollars, one-half contributed by Amos A. Lawrence, of Boston, and one-half by citizens of Kansas, erected the structure called North College. It was this building in which the University of Kansas began its work, and in it the entire work was continued until 1872.<sup>4</sup>

##### THE STATE UNIVERSITY OF KANSAS.

By an act of Congress of January 29, 1861, seventy-two sections of land were set apart and reserved for the use and support of a State university in Kansas.<sup>5</sup> The State accepted the trust in an act of March 1, 1864, which provided for the location of a university at or near Lawrence, and declared the object of the university to be, "to provide the

<sup>1</sup> Letter from the registrar, Frank A. Johnson, January 25, 1889.

<sup>2</sup> Twenty-second annual catalogue, University of Kansas, 95.

<sup>3</sup> Catalogue for 1888, 95.

<sup>4</sup> *Ibid.*, 95.

<sup>5</sup> *Ibid.*, 5.



inhabitants of this State with the means of acquiring a thorough knowledge of the various branches of literature, science, and the arts."

By the same act it was further provided that the university should consist of six departments: (1) The department of science, literature and arts; (2) the department of law; (3) the department of medicine; (4) the department of theory and practice of elementary instruction; (5) the department of agriculture; (6) the normal department. These have not all as yet been fully organized. In the first-named department good courses are furnished, to which reference will be made later. In the second a two-years law course is provided; in the third a preparatory course, simply, of one year. No attention is given to agriculture or at present to normal training,<sup>1</sup> doubtless because there are two other State institutions in which these are specially pursued. By an act of the Legislature in 1885 the board of regents of the university were directed to establish without delay a chair of pharmacy in the institution. There are departments also of music and art.

The board of regents, as constituted by an act of March 1, 1864,<sup>2</sup> consisted of fourteen members, and met for the first time March 21, 1865. A faculty was elected July 19, 1866, and the school was opened September 12, 1866. The catalogue for 1866-67 shows that the students were all, for that year, in the preparatory department, and that they paid a tuition fee of ten dollars, with the exception of a few "orphans of deceased soldiers and those made so by the Quantrell raid."

By an act of the Legislature, which took effect March 16, 1873, the number of members of the board of regents was reduced to seven, six appointed by the Governor and approved by the Senate, the seventh, the chancellor, elected by the board. It is similarly constituted at present.

The regents were empowered "to appoint a requisite number of professors and tutors, and such other officers as they may deem expedient, to regulate the course of instruction, and prescribe, under the advice of professors, the books and authorities to be used in the several departments, and also to confer such degrees and grant such diplomas as are usually conferred and granted by other universities."

In the report of the president to the Superintendent of Public Instruction in 1866, the former says:<sup>3</sup>

#### UNIVERSITY MODELLED AFTER MICHIGAN.

"Michigan University has been adopted as our model, save our basis is broader, consequently making the structure more difficult to rear, but of more value to society when completed. It places the sexes, so far as education is concerned, on an equality. This, without doubt, is both just and expedient. It is no small honor that the Mediterranean

<sup>1</sup> A normal department was organized in 1876 but has been abandoned.

<sup>2</sup> *Statutes*, 2, 1864, 3.

<sup>3</sup> Sixth Annual Report of Superintendent of Public Instruction, 1866, 53.

State should be the first to recognize the rights of woman in her educational system."

"The dangers besetting a State institution," he adds in his report, "are twofold: (1) political, (2) sectarian. Either alone is sufficient to jeopardize the success of any institution of learning." That the public in general stand in this fear of sectarian influence in the schools is witnessed by the following clause in the Constitution of 1859:

"No religious sect or sects shall ever control any part of the common school or university funds of the State."<sup>1</sup>

#### SEMINARY LANDS.

The regent's report for 1870 showed the University to still be in possession of the 46,080 acres of land granted by Congress to the State in an act above mentioned.<sup>2</sup> The land did not find ready sale, and the Legislature of 1879, upon petition of the regents, made the terms of purchase more favorable.<sup>3</sup> The prices previously fixed upon the lands were reduced twenty-five per cent., the rate of interest on deferred payments changed from ten to seven per cent., and the time extended from ten to twenty years, one-tenth to be paid down and the remainder in nineteen equal installments with annual interest. Prior to April 1, 1880, only 29,597 acres had been sold,<sup>4</sup> but these favorable conditions resulted in the immediate sale of a large part of the remaining lands. The principal from the sale of these lands is paid into the State treasury and invested by the State board, the interest alone being available for the current expenses of the institution.

#### APPROPRIATIONS BY THE STATE.

Since 1870 annual appropriations have been made by the Legislature for instruction and various other expenses of the University, and are as follows:<sup>5</sup>

|                        |             |               |              |
|------------------------|-------------|---------------|--------------|
| 1870.....              | \$14,570.33 | 1880-81 ..... | \$33,250.00  |
| 1871.....              | 17,665.00   | 1882-83 ..... | 30,750.00    |
| 1872.....              | 68,200.00   | 1883-84 ..... | 26,500.00    |
| 1873.....              | 24,600.00   | 1884-85 ..... | 33,825.00    |
| 1874.....              | 29,244.81   | 1885-86 ..... | 27,075.00    |
| 1875.....              | 18,201.33   | 1886-87 ..... | 34,350.00    |
| 1876.....              | 22,519.07   | 1887-88 ..... | 31,075.00    |
| 1877 (six months)..... | 11,350.00   | 1888-89 ..... | 58,580.00    |
| 1877-78.....           | 29,850.00   | 1889-90 ..... | 48,630.00    |
| 1878-79.....           | 18,000.00   |               |              |
| 1879-80.....           | 27,700.00   | Total .....   | \$610,585.54 |

The appropriations on the part of the Legislature for buildings,<sup>6</sup> though included in the above totals, may be mentioned separately. In 1872 fifty thousand dollars was appropriated for the completion of a

<sup>1</sup> State Constitution, art. vi, sec. 8.

<sup>2</sup> Regent's Report, 1870, 5.

<sup>3</sup> Catalogue, 1888, 96.

<sup>4</sup> Catalogue, 1888, 98.

<sup>5</sup> Laws for years named.

<sup>6</sup> Catalogue, 1888, 98-101.

new main building begun by a contribution of one hundred thousand dollars from the city of Lawrence. To this amount fifteen thousand dollars was later added for finishing parts of this building and some additional rooms. In 1883 the board of regents were authorized to use eight thousand dollars, interest, and an appropriation of four thousand dollars for the erection of a chemistry building. An appropriation of fifty thousand dollars was made in 1885 for a building for the department of natural history; and sixteen thousand dollars in 1887, for a boiler-house and engine rooms.

No tuition fee is charged in the collegiate courses, but a contingent fee of ten dollars and a graduation fee of five dollars are required.<sup>1</sup>

In the report of the board of regents for 1883-84<sup>2</sup> statistics are quoted touching the income, expenditure for instruction, etc., of fourteen leading colleges of the United States, and the comparison summed up as follows:

"Of all institutions compared, the University of Kansas, though occupying very high rank in the character of results secured, has the smallest endowment, the smallest receipts from endowment, and the smallest receipts from the State; has received no gifts as compared with three hundred thousand dollars to Ann Arbor, half of that to California, thirty thousand dollars to Missouri, and fifteen thousand dollars to Wisconsin—all in a single year; stands sixth and lowest in the list of receipts from students, though only fifth in number of attendance, showing great generosity on the part of the management of the institution; as to gross receipts, stands next to lowest; pays the lowest total amount for instruction; pays next to the lowest salary for president or chancellor, and the lowest salaries to the faculty and assistants; yet demands the greatest number of hours service, and compels them to instruct the largest number of students—more than twice as many as the general average; expends the smallest amount on its library, that most necessary of all the apparatus of instruction, and therefore, naturally, has the smallest library; is next to the lowest in the charges placed on each student, and expends the least for the instruction of each student—a cheapness of which we may not boast.

"Still more briefly, in seventeen points of comparison touching matters essential to good work, and showing generous patronage and support, Kansas stands in nearly every respect at the foot of the list!"

It is pleasing to notice that the appropriations for the support of the university since the above publication have rapidly advanced, and that there is an earnest determination on the part of those in charge to bring the university to the very foremost rank of modern institutions. It verifies what has been stated elsewhere that State education is on the rise; that the era of carelessness, indifference, and experiment is largely passed, and that these institutions, called into existence through the needs of the people, will prove faithful to the cause of their creation.

<sup>1</sup> Catalogue, 1887-1888.

<sup>2</sup> Board of Regents' Report, 1883-84, p.

Occasionally a croaker, or a misinformed philanthropist, or a wily politician may utter his anathemas against State education, and particularly State universities, but it will be of no avail, for the public school system has become the people's birthright, and its foundation is sure.

## KANSAS STATE AGRICULTURAL COLLEGE.

Pursuant to an act of Congress, approved July 2, 1862, "donating public lands to the several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts,"<sup>1</sup> a resolution was passed February 3, 1863, by the Legislature of Kansas accepting its provisions, and an act<sup>2</sup> was passed shortly thereafter locating an agricultural college upon a certain tract of land in Riley County, upon the express condition that the Bluemont Central College Association, in whom the title of the land was vested, should transfer it to the State with all the buildings and appurtenances thereunto, and the apparatus and library belonging to the association. This provision was complied with by the association.

By an act of the Legislature approved March 3, 1863, the college was named the "Kansas State Agricultural College."<sup>3</sup> Its government was vested in a board of regents to consist of the Governor, Secretary of State, Superintendent of Public Instruction, president of the college, and nine others, to be appointed by the Governor and approved by the Senate, with the proviso "that not more than three of those selected shall be members of the same religious denomination."<sup>4</sup>

The powers of the regents were quite similar to those of the university regents.

The college was to consist of four departments<sup>5</sup>: (1) The department of agriculture; (2) the department of mechanic arts; (3) the department of military science and tactics; (4) the department of literature and science, the last including "whatever is taught in any first-class college, embracing English literature, mathematics, natural science, the classics, and modern languages."

For years the department of literature and science was given some prominence, in the eyes of the incoming board of regents as reorganized in 1873, entirely too much prominence, and the result was a radical change. The following quotations are made from their report for 1873:<sup>6</sup>

<sup>1</sup> Laws of United States and Kansas relating to State Agricultural College, 3.

<sup>2</sup> *Ibid.*, 6.

<sup>3</sup> *Ibid.*, 7.

<sup>4</sup> An amendment of 1873 (Laws, p. 17), gave to this board the same constitution as that of the university, viz.: six appointees of the Governor and a chancellor or president, chosen by the board. It was further amended that "there shall not be at any time more than two members appointed from any one county of the State, nor shall any trustee be appointed residing in the county in which any charitable institution is located."

<sup>5</sup> Laws of United States and Kansas, 8.

● <sup>6</sup> Regents' Report, 1873, 192, in Thirteenth Annual Report of Department of Public Instruction.

"While not necessarily ignoring other and minor objects, the leading and controlling object of these<sup>1</sup> institutions should be 'to teach such branches of learning as are related to agriculture and mechanic arts.' A prominence should be given to these branches in the degree that they are actually used by the farmer or mechanic.

"As against the opinion that the aim of these colleges should be to make thoroughly educated men, we affirm that their greater aim should be to make men thoroughly educated farmers."

As a guide to the faculty in preparing a new curriculum the policy of the board was defined in the following resolutions:<sup>2</sup>

"*Resolved*, That the object of this institution is to impart a liberal and practical education to those who desire to qualify themselves for the actual practice of agriculture, the mechanic trades, or industrial arts.

"Prominence shall be given to agriculture and these arts in the proportion that they are severally followed in the State of Kansas.

"Prominence shall be given to the several branches of learning which relate to agriculture and the mechanic arts, according to the directness and value of the relation."

"Believing," they add, "that this college was designed for the masses rather than for a favored few, we shall act accordingly [in adopting a curriculum], avoiding a duplication of the common schools on the one hand, and of the State university and normal schools on the other."

The policy thus initiated has been continued.

The institution was opened September 2, 1863, with four instructors, and fifty-four students, one-half of whom were females.<sup>3</sup> About one-half gave attention to the higher branches, the remainder to the common branches. A tuition fee of four dollars per term was charged in the common branches and of five dollars in the higher.

The president in his report for the first year, 1863, sums up the assets of the institution as follows:<sup>4</sup> "The ninety thousand acres of land for the endowment of the college are mostly located seventy-six thousand acres, and designated, and their minimum value cannot be less than two dollars and fifty cents per acre, making the minimum value of the endowment two hundred and twenty-five thousand dollars. Add to this the value of the college buildings with the library, etc., and one hundred acres of land adjoining, estimated in July last at twenty-five thousand dollars, and since increased by donations in musical instruments, electrical machines, furniture, etc., about nine hundred dollars, and you have the present assets of the institution. About six hundred dollars more are already pledged to the institution by subscription, and this amount is expected to be still largely increased."

It is provided by a legislative act of January, 1866,<sup>5</sup> that the "board

<sup>1</sup> See *Act for Agricultural College*.

<sup>2</sup> *Board's Report*, 1873, 124.

<sup>3</sup> *Report of Superintendent of Public Instruction*, 1863, 35, 36.

<sup>4</sup> *Ibid.*, 35.

<sup>5</sup> *Laws of United States and Kansas*, 11.

of regents shall sell any portion of lands mentioned in the previous section (the public lands granted by Congress July 2, 1862), at a price not less than three dollars per acre, for cash at the time of sale or upon the following conditions of credit, when deemed by them most conducive to the interest of the college, to wit, in eight equal annual installments, with ten per cent. interest on each installment, payable annually." On timber lands one-half the purchase was payable in advance. The amount derived from the sale of these lands, it was further provided should be paid into the State treasury at the end of every three months by the land agents employed, "to be invested in State or United States bonds,<sup>1</sup> and the interest accruing on deferred payments on lands sold, together with the interest derived from any investment, shall be applied to the payment of the current expenses of the State Agricultural College" and to discharge certain debts named.

The Governor was by the same act authorized to issue State bonds to the amount of five thousand five hundred dollars, the proceeds of which were to be used in payment of arrearages and the current expenses of the college. As long as the principal and interest on these bonds remained unpaid, the amount to be applied out of the income from the sale of lands for the current expenses was not to exceed four thousand dollars per annum.

The State seems to have made additional loans in favor of the college, for this act is found in the laws:<sup>2</sup>

"Whereas the State of Kansas has hitherto advanced as a loan from time to time, the several sums necessary to pay the salaries of professors in the [agricultural] college, thus complying with the conditions, required that the institution should go into active operation within a limited time, and securing its benefits to the earlier pioneer settlers in this Commonwealth: Therefore,

*"Be it enacted by the Legislature of the State of Kansas, That the several sums advanced to pay the professors in the Kansas State Agricultural College, from the year 1863 to the year 1869, inclusive, be, and the same are hereby, donated to said college, together with all interest that may have accrued on said sums."*<sup>3</sup>

Two provisos were added to this section of the act, to the effect that the amount so donated should be used, (1) to purchase additional lands for the college farm, to erect buildings, and to develop the agricultural department; (2) to purchase, to the amount of fifteen hundred dollars, a proper set of arms and accoutrements for the use of the drill

<sup>1</sup> This section was amended in 1871 to read (Laws, p. 16): "The amount derived from the sale of (said) lands shall at the end of each month be, by said agent, paid into the treasury of the (said) Agricultural College, to be invested as the board of regents may direct in school district or State bonds, or by note or mortgage on unincumbered real estate worth double the amount loaned thereon."

<sup>2</sup> March 24, 1870, Laws of United States and Kansas, 14.

<sup>3</sup> The amount of debt remitted was \$36,100; Report of president to Superintendent of Public Instruction, 1870, 270.

class in the military department. The State subsequently relieved the college of indebtedness by provisions that it be "paid in permanent improvements on the college grounds," etc.

Twice the State made appropriations in restoration of the endowment and income funds, which, by the provision of the act of Congress donating lands to the States, were to remain undiminished. The appropriation in 1881 for this purpose was \$17,979.09<sup>1</sup>; in 1885, \$4,613.44.<sup>2</sup>

The college, as at first located, was upon the premises of the Blue-mountain College Association, two miles from Manhattan, but in 1875 the furniture and apparatus were removed to the farm of two hundred and fifteen acres one mile from Manhattan.<sup>3</sup> Thereon buildings have been erected by the State, valued at one hundred and twenty-eight thousand dollars. The farm and grounds, furniture, stock, and other illustrative apparatus are valued at over one hundred and twelve thousand dollars.

The annual income from the endowment fund (\$501,436.33)<sup>4</sup> is about thirty-two thousand dollars<sup>5</sup>, and meets all expenses of instruction.

It receives further by an act of Congress approved March 7, 1887, by general appropriation, fifteen thousand dollars each year for the maintenance of an experiment station "to aid in acquiring and diffusing among the people of the United States useful and practical information on subjects connected with agriculture, and to promote scientific investigation and experiment respecting the principles and applications of agricultural science."

The State provides, as the law requires, for the necessary buildings and expenses in management of funds. It has beside, as has been noticed, also aided in payment of salaries of professors.

#### ANNUAL APPROPRIATIONS.

The appropriations granted by the State Legislature are as follows:<sup>6</sup>

|      |                                           |            |
|------|-------------------------------------------|------------|
| 1871 | Salaries                                  | \$2,700.00 |
| 1872 | Salaries                                  | 3,200.00   |
| 1873 | Salaries                                  | 5,200.00   |
| 1874 | Salaries                                  | 7,500.00   |
| 1875 | Salaries and improvements                 | 8,715.00   |
| 1876 | Salaries and improvements                 | 8,919.00   |
| 1877 | Salaries                                  | 1,500.00   |
| 1878 | Salaries                                  | 2,200.00   |
| 1879 | Salaries and dress                        | 22,084.00  |
| 1880 | Salaries                                  | 6,000.00   |
| 1881 | Salaries and dress                        | 13,675.00  |
| 1882 | Salaries and other improvements           | 15,300.00  |
| 1883 | Salaries and dress and other improvements | 20,274.00  |
| 1884 | Salaries and dress                        | 5,180.00   |
| 1885 | Salaries and dress and other improvements | 25,720.00  |

<sup>1</sup> Laws of United States and Kansas, 32.

<sup>2</sup> Id., 42.

<sup>3</sup> Catalog for 1887-88, 17.

<sup>4</sup> Laws of United States and Kansas, 32-45.

|                                     |            |
|-------------------------------------|------------|
| 1881.—Mileage of regents.....       | \$3,000.00 |
| 1883.—Improvements .....            | 12,000.00  |
| 1883.—Mileage.....                  | 3,000.00   |
| 1885.—Improvements .....            | 22,013.00  |
| 1885.—Mileage.....                  | 1,700.00   |
| Special appropriations to 1885..... | 18,822.78  |

The total expenditures for the past twenty-five years, as furnished by the present president, are:

|                                                           |              |
|-----------------------------------------------------------|--------------|
| For buildings and repairs .....                           | \$125,426.81 |
| For apparatus and expenses.....                           | 136,322.47   |
| For expenses of regents in care of lands, funds, etc..... | 50,270.85    |
| Total.....                                                | 312,020.13   |

## SUMMARY.

|                                                           |              |
|-----------------------------------------------------------|--------------|
| Total appropriations for State University (1889) .....    | \$610,585.51 |
| Total appropriations for Agricultural College (1888)..... | 312,020.13   |
| Grand total .....                                         | 922,605.64   |

## NEBRASKA.

## STATE POLICY.

For prompt and continued attention to the founding of a university, and for wise legislation pertaining to the management of school lands and funds, the State of Nebraska stands among the foremost of the group of Commonwealths that make us a nation. Apparently profiting by the unfortunate experiences of some other States, the Legislature has from the first endeavored to follow a course of action which would insure the careful preservation of the national grants, besides adding to them continually by means of grants, taxes, and appropriations. Through this management the university funds have not accumulated as rapidly as they possibly might have done had the lands been thrown upon the market at a low appraisal, yet the benefits accruing from the present course will be far greater and more lasting. It is hardly necessary to state that the foundation of the University of Nebraska rests, as in other Western States, in the munificence of the General Government in granting lands for seminaries of learning. The "enabling act," passed by Congress in 1864, which prepared the way for the admission of the State into the Union, granted the usual seventy-two sections of land for the "use and support of a State University,"<sup>1</sup> and twenty additional sections for public buildings.

## CONSTITUTIONAL PROVISIONS.

The initiative was taken toward the establishment of the university, in the Constitution adopted in 1867, which declares that "schools and

<sup>1</sup>Section 10, Revised Statutes of Nebraska, 1874, 14; U. S. Statutes at Large, Vol. XV, 49.



means of instruction"<sup>71</sup> shall be encouraged; that funds arising from grants of land and other property to the State "for educational and religious purposes shall forever be preserved inviolate and undiminished," and that no school lands shall be sold or alienated<sup>72</sup> "for a less sum than five dollars per acre." Here, at the inception of university legislation, the voice of this people is recognized in the preservation and disposal of its funds. Although but comparatively few lots of land were sold under this price fixed by the first Constitution, the minimum price on all school lands was raised in the second, which was adopted in 1878. It is clearly stated in this latter instrument that "university, agricultural college, common school, or other lands which are held or may hereafter be acquired by the State for educational purposes, shall not be sold for less than seven dollars per acre nor less than the appraised value."<sup>73</sup>

It was further provided that "the general government of the University of Nebraska is, under the direction of the Legislature, vested in a board of six regents, to be styled the regents of the University of Nebraska, who shall be elected by the electors of the State at large • • • for a term of six years."<sup>74</sup> Under these acts, carried by a popular vote, has grown the university of the people. It has been placed at the head of the public educational system of the State, and aims to complete the work begun in the primary and secondary schools. It endeavors to "secure to all an opportunity of liberal culture in literature and science and in such technical and professional courses as shall from time to time be added."<sup>75</sup> With the exception of a small matriculation fee of five dollars, the advantages of the university are offered to all "free of charge for tuition without regard to sex, or race, or place of residence, on the sole condition of possessing the intellectual and moral qualifications requisite for admission to such an institution." In order to harmonize the work of the university with the other parts of the public system, any high school or academy which has adopted a prescribed course of study, "may, on proper application and inspection, be accredited as a preparatory school of the university."<sup>76</sup>

#### THE UNIVERSITY CHARTERED.

The university was chartered by an act<sup>77</sup> of the Legislature, approved February 15, 1869. In this act five departments or colleges were authorized, as follows: (1) A College of Literature, Science, and Arts<sup>78</sup>;

<sup>71</sup> Art. I.

<sup>72</sup> Art. VI, Sec. 1 and 2.

<sup>73</sup> Art. VIII, Sec. 8, Revised Statutes, 39.

<sup>74</sup> Art. VII, Sec. 1, Revised Statutes of Nebraska, 39 (1874).

<sup>75</sup> Laws of Nebraska, 1877-78, 54.

<sup>76</sup> Laws of Nebraska, 1877-78, 54, Revised Statutes, 131.

<sup>77</sup> Laws of Nebraska, 1869, are referred to in this relation to the university.

<sup>78</sup> Laws of Nebraska, 1869, 172.

<sup>79</sup> The act was designated "The College of Ancient and Modern Literature and the Natural Sciences."

(2) an Industrial College, embracing agriculture, practical science, civil engineering, and the mechanic arts; (3) a College of Medicine; (4) a College of Law; and (5) a College of the Fine Arts. The organization of these colleges was delegated to the board of regents constituted by the Governor, the State Superintendent of Public Instruction, and the chancellor of the university, as *ex-officio* members, and nine others appointed by the Governor.<sup>1</sup>

Only three of these colleges have been organized, viz, literature, industrial, and medicine. The last named was organized in 1882 and was suspended in 1887.

Steps have been taken toward instituting a college of fine arts.

In accepting the national grant for agricultural colleges, Nebraska joined it with the seminary lands heretofore mentioned, thus consolidating the entire endowment fund. It was enacted that "the State university and the agricultural college shall be united as one educational institution and shall be located upon a reservation selected by the commissioners in said Lincoln."<sup>2</sup>

The buildings were to be erected at Lincoln as soon as funds could be procured<sup>3</sup> from the proceeds of the sales of land donated to the State for that purpose.

#### MANAGEMENT OF SCHOOL LANDS.

Commissioners were appointed in 1867 to select the university and agricultural college lands.<sup>4</sup> The lands were to be appraised in tracts of forty acres each, with the exception of wooded lands, which were to be appraised in lots of ten acres each. These lands were to be sold at public auction to the highest bidder, provided that they should not be sold for less than the appraised value.<sup>5</sup> Unsold lands were to be leased for not less than six per cent. of their appraised value,<sup>6</sup> and the proceeds of sales and rentals were to be invested in United States securities bearing not less than six per cent. per annum on the investment. The above rules were slightly modified by subsequent acts. "An act to provide for the registry, sale, leasing, and management of all public lands, and funds set apart for educational purposes and for the investment of funds arising from the sale of such funds,"<sup>7</sup> approved February 15, 1877, renewed and enlarged the former conditions. The lands were to be sold as before, and those not sold were to be leased for a period of twenty-five years at not less than six per cent. on the appraised value, being subject to reappraisal every year. The lands could be called in prior

<sup>1</sup> In 1875 this number was reduced to six.

<sup>2</sup> Revised Statutes of Nebraska, chap. 22, sec. 11, p. 184.

<sup>3</sup> Laws of Nebraska, 1867, House, third session.

<sup>4</sup> Act of Assembly, 1867, House, third session, 60.

<sup>5</sup> Chapter 20, Revised Statutes, secs. 4 and 7, 479; Laws, 1867, 37.

<sup>6</sup> Laws, 1867, 55.

<sup>7</sup> Laws of 1877, 174.

means of instruction"<sup>71</sup> shall be encouraged; that funds arising from grants of land and other property to the State "for educational and religious purposes shall forever be preserved inviolate and undiminished," and that no school lands shall be sold or alienated<sup>72</sup> "for a less sum than five dollars per acre." Here, at the inception of university legislation, the voice of this people is recognized in the preservation and disposal of its funds. Although but comparatively few lots of land were sold under this price fixed by the first Constitution, the minimum price on all school lands was raised in the second, which was adopted in 1878. It is clearly stated in this latter instrument that "university, agricultural college, common school, or other lands which are held or may hereafter be acquired by the State for educational purposes, shall not be sold for less than seven dollars per acre nor less than the appraised value."

It was further provided that "the general government of the University of Nebraska is, under the direction of the Legislature, vested in a board of six regents, to be styled the regents of the University of Nebraska, who shall be elected by the electors of the State at large • • • for a term of six years."<sup>74</sup> Under these acts, carried by a popular vote, has grown the university of the people. It has been placed at the head of the public educational system of the State, and aims to complete the work begun in the primary and secondary schools. It endeavors to "secure to all an opportunity of liberal culture in literature and science and in such technical and professional courses as shall from time to time be added."<sup>75</sup> With the exception of a small matriculation fee of five dollars, the advantages of the university are offered to all "free of charge for tuition without regard to sex, or race, or place of residence, on the sole condition of possessing the intellectual and moral qualifications requisite for admission to such an institution." In order to harmonize the work of the university with the other parts of the public system, any high school or academy which has adopted a prescribed course of study, "may, on proper application and inspection, be accredited as a preparatory school of the university."<sup>77</sup>

#### THE UNIVERSITY CHARTERED.

The university was chartered by an act<sup>78</sup> of the Legislature, approved February 15, 1869. In this act five departments or colleges were authorized, as follows: (1) A College of Literature, Science, and Arts<sup>79</sup>;

<sup>71</sup> Art. I.

<sup>72</sup> Art. VII, sec. 1 and 2.

<sup>73</sup> Art. VII, sec. 3. Revised Statutes, 36.

<sup>74</sup> Art. VII, sec. 4. Revised Statutes of Nebraska, 20. (1874.)

<sup>75</sup> Art. VII, sec. 5. (1877-78, 84.)

<sup>76</sup> Art. VII, sec. 6. (1874 and 1875. Revised Stat., 31.)

<sup>77</sup> Art. VII, sec. 7. (1874 and 1875. Revised Stat., 32.)

<sup>78</sup> Laws of Nebraska, 1869, 172.

<sup>79</sup> It is now designated "The College of Ancient and Modern Literature and the Natural Sciences."

(2) an Industrial College, embracing agriculture, practical science, civil engineering, and the mechanic arts; (3) a College of Medicine; (4) a College of Law; and (5) a College of the Fine Arts. The organization of these colleges was delegated to the board of regents constituted by the Governor, the State Superintendent of Public Instruction, and the chancellor of the university, as *ex-officio* members, and nine others appointed by the Governor.<sup>1</sup>

Only three of these colleges have been organized, viz, literature, industrial, and medicine. The last named was organized in 1882 and was suspended in 1887.

Steps have been taken toward instituting a college of fine arts.

In accepting the national grant for agricultural colleges, Nebraska joined it with the seminary lands heretofore mentioned, thus consolidating the entire endowment fund. It was enacted that "the State university and the agricultural college shall be united as one educational institution and shall be located upon a reservation selected by the commissioners in said Lincoln."<sup>2</sup>

The buildings were to be erected at Lincoln as soon as funds could be procured<sup>3</sup> from the proceeds of the sales of land donated to the State for that purpose.

#### MANAGEMENT OF SCHOOL LANDS.

Commissioners were appointed in 1867 to select the university and agricultural college lands.<sup>4</sup> The lands were to be appraised in tracts of forty acres each, with the exception of wooded lands, which were to be appraised in lots of ten acres each. These lands were to be sold at public auction to the highest bidder, provided that they should not be sold for less than the appraised value.<sup>5</sup> Unsold lands were to be leased for not less than six per cent. of their appraised value,<sup>6</sup> and the proceeds of sales and rentals were to be invested in United States securities bearing not less than six per cent. per annum on the investment. The above rules were slightly modified by subsequent acts. "An act to provide for the registry, sale, leasing, and management of all public lands, and funds set apart for educational purposes and for the investment of funds arising from the sale of such funds,"<sup>7</sup> approved February 15, 1877, renewed and enlarged the former conditions. The lands were to be sold as before, and those not sold were to be leased for a period of twenty-five years at not less than six per cent. on the appraised value, being subject to reappraisal every year. The lands could be called in prior

<sup>1</sup> In 1870 this number was reduced to six.

<sup>2</sup> Revised Statutes of Nebraska, chap. 82, sec. 11, p. 184.

<sup>3</sup> Laws of Nebraska, 1867, House, third session.

<sup>4</sup> Act of Assembly, 1867, House, third session, 60.

<sup>5</sup> Chapter 80, Revised Statutes, secs. 4 and 5, 479; Laws, 1867, 37.

<sup>6</sup> Laws, 1867, 55.

<sup>7</sup> Laws of 1877, 174.

to the expiration of the twenty-five years if so determined by the board of commissioners.<sup>1</sup>

The value of long leases, with frequent appraisals, and opportunities for sales represent the best method of dealing with public lands. In this way the "unearned increment" and the increasing rent will accrue to the holder.

The proceeds of the sales were to be invested in United States securities, as under prior enactment, while rents were to pass into a separate fund.

There are two funds created, the endowment fund and the regent's fund. The former is composed of the permanent investments of the proceeds of the sales of the lands granted to the State by Congress. This fund is kept by the financier in two separate accounts, the university and the agricultural college account. The second is the available fund arising from rent, interest, taxes, etc.<sup>2</sup>

Nearly the whole body of public university lands are held by the institution, though the sales are progressing and there are a considerable number of leases. The following statement is taken from a report made in 1882.<sup>3</sup>

*Agricultural college lands.*

|                                                                             |           |
|-----------------------------------------------------------------------------|-----------|
| Number of acres belonging to the State November 30, 1860 .....              | 89,422.79 |
| Number of acres leased from November 30, 1860, to December 1, 1882 .....    | 17,522.79 |
| Number of acres sold on time from November 30, 1860, to December 1, 1882 .. | 2,877.61  |

*University lands.*

|                                                                             |           |
|-----------------------------------------------------------------------------|-----------|
| Number of acres belonging to the State December 1, 1860 .....               | 45,639.88 |
| Number of acres leased from November 30, 1860, to December 1, 1882 .....    | 6,094.32  |
| Number of acres sold on time from November 30, 1860, to December 1, 1882 .. | 2,367.50  |

The aggregate number of acres granted to the State by Congress was 136,040. It appears from the above statement that at this date (December 1, 1882) patents had been granted on less than 2,367.50 acres, while the remainder, 134,402.61 acres were still in the hands of the State. Two sections were set apart for a model and experimental farm.

**REVENUES.**

The first permanent tax was voted for the benefit of the university in 1869, when a tax of one mill on each dollar of taxable property was levied for the year 1869 and annually thereafter.<sup>4</sup>

This rate was changed in 1870-71 to one-fourth of a mill, and subsequently into three-eighths of a mill on a dollar of the grand valuation of the State.<sup>5</sup>

<sup>1</sup> Revised Statutes, chap. 40, secs. 17 and 19; Laws, 1879, p. 110.

<sup>2</sup> Revised Statutes, chap. 80, p. 513.

<sup>3</sup> Report of the public officers of Nebraska, 1881-82; Public lands, 15.

<sup>4</sup> Laws 1869, p. 126.

<sup>5</sup> Laws 1870-71, p. 116.

The present revenues of the university are derived from three sources, of which the principal one is the tax of three-eighths of a mill on a dollar just alluded to.

The next in importance is the revenue on the United States land endowment.

Although the income from taxation is gaining each year, the latter source will, doubtless, in time, be by far the more productive. The third source of revenue is very small as compared with the other two sources, that is the matriculation and term fees. The financial statement in the biennial report of the board of regents shows a total biennial income of \$81,924, seven-eighths of this arising from the State tax, nearly one-eighth from the income on land endowment, and the remainder from fees.<sup>1</sup> The regents' report of 1886 shows a biennial income for the two years ending with 1886, of \$155,709.85. Nearly three-fifths of this is yielded by the State tax, two-fifths from the income on land, and a small amount paid by students for matriculation, etc., forming the remainder.<sup>2</sup> Although the income has nearly doubled in four years, the income on land has gained rapidly on the State tax.

#### SPECIAL APPROPRIATIONS BY THE STATE.

The Legislature of Nebraska has from time to time made appropriations for university buildings and improvements. The following are the principal items of expense:

|                                                |         |
|------------------------------------------------|---------|
| 1883.—For medical college .....                | \$2,000 |
| 1884.—For steam heating .....                  | 10,000  |
| 1884.—For chemical laboratory .....            | 25,000  |
| 1886.—For industrial college buildings .....   | 50,000  |
| 1886.—For repairs .....                        | 5,500   |
| 1887.—Grant Memorial Hall .....                | 15,000  |
| Making in all for special appropriations ..... | 107,500 |

In addition to this the sum of \$554,195.49 has been appropriated for the support of the university through the tax of three-eighths of a mill on each dollar of the grand assessment roll.

The following statement has been furnished me through the courtesy of Prof. H. W. Caldwell, of the University of Nebraska:

#### *Nebraska State University, biennial income.<sup>3</sup>*

|                                                   |              |
|---------------------------------------------------|--------------|
| 1869-70.—State tax, one mill .....                | \$26,436.74  |
| 1871-72.—State tax, one mill .....                | 50,938.65    |
| 1873-74.—State tax, three-eighths of a mill ..... | 31,885.70    |
| Land .....                                        | 126.76       |
| Interest on loan to the State .....               | 2,280.00     |
| Total .....                                       | \$111,727.85 |

<sup>1</sup> History and Resources of the University of Nebraska, 1884.

<sup>2</sup> Regents' Report 1886, 16.

<sup>3</sup> The biennial really is from December 1, 1868, to December 1, 1870, and from December 1, 1870, to December 1, 1872, etc.

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|                                                              |             |             |
|--------------------------------------------------------------|-------------|-------------|
| 1-75-76.—State tax, three-eighths of a mill .....            | \$34,739.13 |             |
| Land .....                                                   | 101.72      |             |
| Interest .....                                               | 720.00      |             |
| Total .....                                                  |             | \$35,560.85 |
| 1-77-78.—State tax, three-eighths of a mill .....            | 40,314.39   |             |
| University land .....                                        | 709.73      |             |
| Library fund .....                                           | 1,096.31    |             |
| Total .....                                                  |             | 42,120.43   |
| 1-79-80.—State tax, three-eighths of a mill .....            | 52,031.36   |             |
| University land .....                                        | 4,634.09    |             |
| Interest on bonds .....                                      | 155.28      |             |
| Library fund .....                                           | 394.20      |             |
| Total .....                                                  |             | 57,214.93   |
| 18-1-82.—State tax, three-eighths of a mill .....            | 70,307.90   |             |
| University land .....                                        | 5,678.84    |             |
| Agricultural land .....                                      | 2,137.07    |             |
| Interest on bonds .....                                      | 300.00      |             |
| Library fund .....                                           | 625.00      |             |
| Total .....                                                  |             | 79,118.81   |
| 1-83-84.—State tax, three-eighths of a mill .....            | 76,434.71   |             |
| University lands .....                                       | 15,530.84   |             |
| Agricultural land .....                                      | 13,311.97   |             |
| Interest on bonds .....                                      | 425.00      |             |
| Library fund .....                                           | 1,410.00    |             |
| Total .....                                                  |             | 107,112.52  |
| 1-85-86.—State tax, three-eighths of a mill .....            | 56,027.87   |             |
| University land .....                                        | 18,771.62   |             |
| Agricultural land .....                                      | 41,313.56   |             |
| Interest on bonds .....                                      | 2,955.95    |             |
| Library fund .....                                           | 1,165.00    |             |
| Total .....                                                  |             | 120,233.99  |
| 1-87-88.—State tax, three-eighths of a mill .....            | 110,179.74  |             |
| University land .....                                        | 18,652.98   |             |
| Agricultural land .....                                      | 37,650.93   |             |
| Interest on bonds .....                                      | 2,670.00    |             |
| Library fund .....                                           | 1,435.00    |             |
| Total .....                                                  |             | 170,588.65  |
| 1-89-90.—Estimate Income all sources \$225,000 to \$250,000. |             |             |

## COLORADO.

In the historical development of education in the United States it is surprising to observe the rapidity with which the communities and States of the far West have established systems of education.

Following the example of the early colonists of the Atlantic coast, the settlers of the West have scarcely provided shelter and food for their families before plans were made for schools and education.

The chief attractions of Colorado being those of mining and stock-raising, the elements that made up its early population differ somewhat from those of the great farming States of the Mississippi Valley. In the latter States the settlers were seeking homes for their families; in Colorado they were mostly adventurers without families, seeking wealth. Nevertheless these adventurers were of the sturdy sort, coming from the older States, where they were familiar with the best systems of education, and their sentiments in favor of schools developed at an early date in the history of the Territory.

## FIRST LEGISLATION.

At the first Legislative Assembly held at Denver, in 1861, a school law was framed, patterned largely after that then in existence in the State of Illinois,<sup>1</sup> and at the same session a university was incorporated, to be located at Boulder. The act providing for a university remained a dead letter on the statute-books until 1870.<sup>2</sup>

At the second session of the Legislature a novel method was adopted to raise the ordinary school revenues. A part of the act reads as follows: "That hereafter when any new mineral lode of either gold bearing quartz, silver, or other valuable metal shall be discovered in this Territory, one claim of one hundred feet in length on such lode shall be set apart and held in perpetuity for the use and benefit of schools in this Territory, subject to the control of the Legislative Assembly."<sup>3</sup>

This seemed to promise an ample support for the schools, but the actual results were insignificant. "Not one per cent. of the thousands of claims so located ever contributed a dollar to the school fund."<sup>4</sup>

In the year 1865 the inhabitants of the Territory elected delegates to a constitutional convention, and a State Constitution was framed with the following proviso in favor of higher education: "The Legislative Assembly shall encourage the promotion of intellectual, moral, scientific, and agricultural improvement by establishing a uniform system of public schools of a higher grade, embracing normal, preparatory, and university departments; but no religious institution of a strictly sectarian character shall receive the aid of the State."<sup>5</sup>

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<sup>1</sup> Education in Colorado, 12.

<sup>2</sup> Report, of the Commissioner of Education, 1876, 39.

<sup>3</sup> Education in Colorado, 12 (quoted).

<sup>4</sup> *Ibid.*, 13.

<sup>5</sup> Art. XIII, sec. 3, Circular of Education, No. 7, 99.



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The people supposed that they were acting under an enabling-act passed by Congress in 1864, when supporting the above measure, but their proceedings were deemed irregular by the President, and they therefore failed to receive recognition from him.<sup>1</sup>

### UNIVERSITY OF COLORADO AT BOULDER.

The act authorizing a State university created a board of fifteen trustees, and this number was increased to twenty in 1870. The same year an organization was effected, and a committee authorized to select a site. In the following year three public-spirited citizens donated to the university fifty two acres of land adjoining the city of Boulder, valued at five thousand dollars.<sup>2</sup> Efforts were made in 1872 to obtain a grant from the Legislature for building purposes, but nothing was effected until 1874, when fifteen thousand dollars was appropriated on the condition that a like sum should be raised among the people. This was accomplished, and in May, 1875, the sum of thirty thousand dollars thus raised was placed to the credit of the university.<sup>3</sup> In the same year Congress set apart seventy two sections of land for the support of the State University. The Constitution adopted in the following year 1876 provided that the university at Boulder should become an institution of the State, thus entitling it to the lands appropriated by Congress, and further, made provision for the management and control of the university.

The organic act establishing the university and providing for its maintenance dates from March 15, 1877. In this act the object of the institution is set forth in the following words:

"To provide the best and most efficient means of imparting to young men and women, on equal terms, a liberal education and thorough knowledge of the different branches of literature, the arts, and the sciences, and their varied applications."

The first building was completed in 1876 and the school opened the following year.

In 1878, in support of the university the Legislature voted, at that time, a tax of one-fifth of a mill upon the assessed value of all property in the State, and made provision to secure a permanent fund from the sale of the lands donated by Congress.

The Legislature has also made the following special appropriations: In 1880 a sum of seven thousand dollars was voted for apparatus, for the year ending in 1881 a special fund was raised by a tax levy of one mill on a mill for the two succeeding years 1881-82, which amounted to about thirty thousand dollars.<sup>4</sup> This fund was expended in carrying the grounds and on additional buildings, furniture, books, etc.

<sup>1</sup>Chapman, *op. cit.*, No. 7, 9.  
<sup>2</sup>Circular, 1875-76.

By Art. IX, sections 12, 13, and 14, of the Constitution, the number of regents is fixed at six, to be elected by the people.

The State has provided liberally for the education of youth, and the young institution is maintained by the constant support of the State. The treasurer's report of 1886 shows that the total receipts of the university for the fiscal year ending September 30, 1886, amount to \$74,432, of which \$1,047 was from a balance of the preceding year, \$50,212.62 from the general fund, and \$22,996.85 from the special fund.<sup>1</sup>

STATE AGRICULTURAL COLLEGE.

Colorado supports three State institutions for higher education, the State university already referred to, the Agricultural College at Fort Collins, and the School of Mines at Golden. The Agricultural College at Fort Collins was established by an act of the Assembly, February 11, 1870, in accordance with the conditions of the Congressional land grant of 1862, but the institution was not formally organized until 1877. The State Legislature levies an annual tax of one-fifth of a mill on the assessed valuation of the property in the State for its support.<sup>2</sup> Prior to this, in 1881, five thousand dollars was appropriated for a new dormitory and for furnishing the laboratory.<sup>3</sup> In the same year a tax of one-fifth of one mill was voted for two years, 1881 and 1882.<sup>4</sup>

STATE SCHOOL OF MINES.

The State School of Mines, located at Golden, was organized by and receives its support chiefly from the State. Like the State university and the Agricultural College, it receives one fifth of a mill on each dollar of the assessed value of the property in the State. This makes the permanent support of higher education by the State, to be three-fifths of a mill on each dollar of taxable property.<sup>5</sup>

By the treasurer's report of 1885-86 the value of the property is estimated to be \$50,717, and the total receipts for the year to be \$43,674.73. Of this latter sum \$40,798.30 was received from State taxation.<sup>6</sup>

SUMMARY OF GRANTS.

The following is a statement pertaining to the financial history of the Agricultural College at Fort Collins.<sup>7</sup>

<sup>1</sup> Report State Superintendent, 1886, 81-82.

<sup>2</sup> Act of Assembly, 1883, 17.

<sup>3</sup> Acts of Assembly, 1881, 27.

<sup>4</sup> *Ibid.*, 29.

<sup>5</sup> State Superintendent's Report, 1885-86, 15.

<sup>6</sup> Report Superintendent Public Instruction, 1885-86, 104.

<sup>7</sup> This statement was furnished by the courtesy of the president, Mr. Charles L. Ingersoll.

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*Table showing the State expenditures for higher education by the Colorado Legislature.*

| Year. | State valuation.                     | Tax.          | Gross income. | Special legislative appropriations. | Remarks.                                                                                |
|-------|--------------------------------------|---------------|---------------|-------------------------------------|-----------------------------------------------------------------------------------------|
|       |                                      | <i>Mills.</i> |               |                                     |                                                                                         |
| 1877  | \$41,473,916.36                      | ♂             | \$4,345.39    |                                     | All used in building. Corner-stone laid July 29, 1878. School opened September 1, 1879. |
| 1878  | 43,071,648.28                        | ♂             | 4,307.28      |                                     |                                                                                         |
| 1879  | 50,315,803.30                        | ♂             | 5,831.33      |                                     |                                                                                         |
| 1880  | 71,008,716.29                        | ♂             | 7,369.87      |                                     | Special appropriation for dormitory and laboratory furnishing. Tax for two years only.  |
| 1881  | 81,155,205.48                        | ♂             | 12,227.06     | \$3,000                             |                                                                                         |
| 1882  | 100,449,083.57                       | ♂             | 20,888.13     |                                     |                                                                                         |
| 1883  | 110,140,756.21                       | ♂             | 22,151.05     | 10,000                              | Special appropriation for mechanical shop and conservatory. Tax made continuous.        |
| 1884  | 115,075,914.51                       | ♂             | 23,115.00     |                                     |                                                                                         |
| 1885  | 117,439,193.90                       | ♂             | 23,084.04     |                                     |                                                                                         |
| 1886  | 124,292,710.00                       | ♂             | 24,852.94     |                                     |                                                                                         |
| 1887  | 131,727,684.37                       | ♂             | 26,384.73     |                                     |                                                                                         |
| 1888  | 138,812,466.95                       | ♂             | 31,762.45     |                                     |                                                                                         |
| 1889  | Valuation, Mar. 1                    | ♂             |               | 10,000                              | For main building (addition).                                                           |
|       | Total receipts State appropriations. |               | 217,221.35    | 33,000                              |                                                                                         |

|                                                                            |                  |
|----------------------------------------------------------------------------|------------------|
| Gross amount one-tenth and one-fifth mill tax .....                        | \$217,221.35     |
| Special appropriations, including 1889 .....                               | 33,000.00        |
| From reservation on land-grant fund approximately to January 1, 1890 ..... | 2,500.00         |
| Hatch experiment fund to January, 1890 .....                               | 37,500.00        |
|                                                                            | <hr/> 287,221.35 |
| Less: one-cent tax, \$20,000, approximately each year twelve years .....   | \$24,000.00      |
| Less amount to December 1, 1888 .....                                      | 98,774.80        |
| Less amount for permanent improvements in 1889 .....                       | 25,000.00        |
|                                                                            | <hr/> 117,774.86 |

|                                                                                                                     |            |
|---------------------------------------------------------------------------------------------------------------------|------------|
| Balance of school from February, 1877, to January 1, 1890, less amount for permanent improvements .....             | 139,412.49 |
| Average cost of school for ten years, \$13,941.25 annually, and experiment station for two years and one-half ..... |            |

## SUMMARY.

### State University at Boulder.

|                                |                 |
|--------------------------------|-----------------|
| Special appropriation .....    | \$32,000.00     |
| From one-tenth of a mill ..... | 20,075.40       |
| Total .....                    | <hr/> 52,075.40 |

### Agricultural College at Fort Collins.

|                               |                  |
|-------------------------------|------------------|
| Special appropriation .....   | 33,000.00        |
| From one-tenth mill tax ..... | 217,221.35       |
| Total .....                   | <hr/> 250,221.35 |

*State School of Mines at Golden.*

|                                  |                   |
|----------------------------------|-------------------|
| Special appropriations.....      | \$30,000.00       |
| From one-fifth mill tax .....    | 210,101.64        |
| <b>Total</b> .....               | <b>240,101.64</b> |
| <b>Entire expenditures</b> ..... | <b>791,398.39</b> |

## NEVADA.

## FOUNDING OF THE UNIVERSITY OF NEVADA.

Nevada made ample provision in the first Constitution, adopted in 1864, for a complete system of State schools, and has followed up the declaration of the Constitution by legislative enactments as far as circumstances would permit. The first section under education asserts that "The Legislature shall encourage by all suitable means the promotion of intellectual, literary, scientific, mining, mechanical, agricultural, and moral improvement."<sup>1</sup>

Under this broad declaration the Constitution proceeds to provide for "a uniform system of common schools," the establishment of normal schools, and a "State university which shall embrace departments for agriculture, mechanic arts, and mining." It also authorized the establishment of a school fund by devoting all the public lands granted by Congress by the acts of 1787, 1862, and 1841,<sup>2</sup> together with all escheats of land, to purposes of education.

The first Legislature<sup>3</sup> passed an act, approved March 9, 1865, entitled "An act to establish an agricultural and mechanical college in Washoe County in this State."<sup>4</sup> This college became an integral part of the public school system which was organized on the 20th of March, 1865.<sup>5</sup> However, no funds were given into the hands of the regents, and the university was not located according to the provisions of the Constitution until March 7, 1873. At this date an act was approved locating the university at the town of Elko, provided that the people in that town convey within one year to the board of regents of the State university the title of not less than twenty thousand acres, with buildings for a preparatory department costing at least ten thousand dollars. The Central Pacific Railroad Company donated a site, and the citizens of Elko more than fulfilled their part by erecting a building costing over eighteen thousand dollars.

<sup>1</sup> Art. IX, sec. 1, Constitution, 1864.

<sup>2</sup> U. S. Statutes at Large, V, p. 455; 500,000-acre grant.

<sup>3</sup> The first Territorial Legislature in 1861 passed an act to establish a seminary of learning at Carson City, but nothing came of it.

<sup>4</sup> Laws of 1864-65, 349.

<sup>5</sup> Laws of Nevada, II, 253.

In 1875 a building was erected for a dormitory costing, furnished, \$7,397, for the purpose of boarding students from abroad; but not over five scholars patronized it at any one time. The university preparatory department was opened in 1874 with seven students.

The University of Nevada, at Elko, "did not realize the anticipations of the board of regents;" in other words, it was a failure. While during the eleven years of its existence at Elko, classes were maintained in algebra, geometry, chemistry, physiology, history, and the common English branches, it would scarcely bear the name of a modern high school.

The regents' reported in 1883-84 that a change was desirable. A bill was proposed for the removal of the university to Carson City, but it failed to pass. Another bill, approved by the Governor March 7, 1885, authorized the removal to Reno (Washoe County), on the conditions that the board of commissioners of Washoe County pay into the treasury of Elko twenty thousand dollars, and to the board of regents five thousand dollars; provided further, that ten thousand dollars be appropriated by the Legislature, and this with the five thousand dollars be expended in the erection of a building not to cost over twenty thousand dollars.<sup>1</sup>

The board of regents proceeded at once to carry out the provisions of the act. They purchased a site of ten acres for \$1,250. On June 1, 1885, the board of commissioners to carry out the stipulations of the said act issued bonds to the amount of twenty-five thousand dollars.

#### FUNDS AND ENDOWMENTS.

The Constitution provided in section six, article nine, that there should be levied "a special tax of one-half mill on the dollar, on all taxable property in the State, in addition to the other means provided, for the support and maintenance of said university and common schools."

The permanent funds are derived from the sale of the Congressional grant of 1862 of ninety thousand acres, nearly all of which have been sold. In 1866 Congress granted to the State the customary two townships of public lands for "seminary" purposes.

From a statement rendered December 31, 1885, the following facts are gleaned:

|                                                                                       |             |
|---------------------------------------------------------------------------------------|-------------|
| Amount of permanent fund derived from sale of lands of the agricultural grant of 1862 | \$79,227.92 |
| Interest on 1/2 per cent. the same                                                    | 15,192.97   |
| Sum carried over from 1884-85                                                         |             |
| Amount of permanent fund of seminary grant of 1866                                    | 31,227.20   |
| Interest on 1/2 per cent. the same                                                    | 9,758.37    |
| Sum carried over from 1884-85                                                         |             |
| <hr/>                                                                                 | <hr/>       |
| Total of permanent fund and interest                                                  | 135,471.46  |
| Total of other fund transfers                                                         | 141.25      |

<sup>1</sup> Register, Reno, 11, 2.

<sup>2</sup> Register of the University of Nevada, 7.

<sup>3</sup> *Ibid.*, 6.

The amount of money expended for university purposes since its opening up to the date (1887) of the last report of the regents was \$57,138.28; only \$17,760.20 being derived from the income on permanent funds, the remainder, \$39,378.08, having been appropriated by the State Legislature.<sup>1</sup>

## CALIFORNIA.

### FIRST ORGANIZED EFFORTS FOR EDUCATION.

The first organized efforts toward higher education in California were made by the various religious denominations in their establishment of Christian schools. And these institutions wrought a noble work in thus breaking the fallow-ground and laying the foundation of that great system of advanced learning which is to-day the pride of the State. Usually without necessary means, and oftentimes with the meagre products of self-denial, these colleges and seminaries raised the standard of liberal education.

During the first twenty years of existence, California was indebted to private institutions for the entire benefits received from higher education; and if these institutions could not be favorably compared with older Eastern colleges, possessing many superior advantages; if they professed to give but a limited education and often failed to fulfil what they professed, still they supplied the demand for higher education in pioneer days, and hundreds of men who received their early training and culture in such schools have since risen to positions of honor and usefulness throughout the State. But it is not our purpose to describe the work of these institutions; suffice it to say that whereas a number have succumbed to the rude shocks of fortune or to injudicious management, the majority have developed with the rapid growth of California and fill their own mission in supplying the needs of the times.

### EARLY LEGISLATION.

The first Legislature of 1849-50 made no provision for education, the few schools then established being carried on by private enterprise or through the agency of town councils, but the Constitution adopted in 1849 provided for a system of education. It states that "the Legislature shall encourage by suitable means the promotion of intellectual, scientific, moral, and agricultural improvement."<sup>2</sup> It further provides for the appropriation of the proceeds of five hundred thousand acres of land toward a permanent school fund, and the protection and preservation of the United States seminary grant for a university.

No school law was formed until 1851, and this law, following the provisions of the Constitution, stipulates that the schools shall be of primary, intermediate, grammar, and high school grades, but says nothing

<sup>1</sup>Regents' Report, 1883-84, 2.

<sup>2</sup>Sec. 2, Art. IX.

about a university. One of the remarkable laws of this code represents the early policy of the State, which has in recent times been wholly departed from.

In section 10 we find these words: "If a school be formed by the enterprise of a religious society, in which all the educational branches are taught, and which from its private and public examination will it to be well conducted, such school shall be allowed a compensation from the public school fund in proportion to the number of its pupils in the same manner as is provided for district schools by this act."

Sec. 11 says: "Schools established under charitable auspices, orphan asylums, schools for blind, almshouse schools, etc., such as shall be subject to the general supervision of laws on education, but under the immediate management of their respective trustees, managers, and directors; and said schools shall participate in the apportionment of the school moneys in the same manner as other common schools."<sup>1</sup>

As nearly all of the colleges and seminaries had preparatory courses in connection with their collegiate departments, section 10 of this law provided for and by the State to private or sectarian institutions. By a law of 1852 the Catholics were allowed their pro rata of the public fund, but by an act approved May 3, 1852,<sup>2</sup> which levied the first State school tax, the foregoing action was annulled by providing that no school should receive any apportionment of public money unless free from all denominational or sectarian bias, control, or influence whatever. Beyond this the State gave assistance to high schools, some of which attained first rank, but all of these are now supported by local taxation.

#### THE STATE UNIVERSITY.

The crowning work of the State in the support of education is found in the university at Berkeley. In fact all that the State has ever done in the name of higher education worthy of mention, has been centered about this point. From the time of organization as a State, California has shown a disposition to foster the grants made by the General Government, and has at the same time provided a constant support for the university by taxation, appropriation, and endowment.

The grant of two whole sections of land from the General Government in 1854, for a seminary, and an additional grant in the same year of ten sections for building purposes, gave California an opportunity to realize a handsome sum by judicious management; but owing to hasty sales of more than one hundred thousand dollars was realized from these two sources. Yet this was more satisfactory than the profits received from the five hundred thousand acres granted for internal improvement by the United States in an act of 1841.<sup>3</sup> California received but six hun-

<sup>1</sup> *California State System History of Public School System of California*, 15.

<sup>2</sup> *Ibid.*, 16.

<sup>3</sup> *General Statistics of United States*.

<sup>4</sup> *Statistics of United States*.

dred thousand dollars from this magnificent gift, and the entire sum was devoted to the general school fund.

Nothing beyond the sale of lands was done toward the establishment of a university in California until 1866. In the meantime the act of the General Government in 1862 had given to this State one hundred and fifty thousand acres of land for the support of an Agricultural and Mechanical College. In 1864 the Legislature appointed a board of commissioners to prepare a report favorable to the founding of a State university; this board was composed of Prof. J. D. Whitney, State Geologist; J. F. Houghton, Surveyor General, and John Swett, Superintendent of Public Instruction. Among other considerations it was recommended that the different funds be consolidated and devoted to one institution to be located in San Francisco.

An act was finally approved by the Legislature on March 31, 1866, establishing the Agricultural, Mining, and Mechanical College in accordance with the United States act of July 2, 1862. Section first in defining the object of the college says that "the design of the institution in fulfillment of the injunction of the Constitution is to afford thorough instruction in agriculture, mining, and the sciences connected therewith. To effect the object most completely the institution shall combine physical with intellectual education and it shall be a high seminary of learning."<sup>1</sup> This act provided for a complete organization of the college, but no effective action was taken until two years later when another law was passed establishing the university at Berkeley.

The trustees<sup>2</sup> of the College of California formally presented the site and property of that institution to the trustees of the Agricultural and Mechanical College with the provision that the Mechanical College should be located on their site at Berkeley; and on the other hand the said trustees of California College offered to give up their own charter and donate to the State their buildings, apparatus and property provided that it should be united with the various grants to form the University of California. After careful deliberation the proposition was accepted and the institution known as the State University with an Agricultural and Mechanical College was established at Berkeley. The property received from the College of California amounted to about one hundred and twenty thousand dollars in value, at the time of the gift. The university was established in 1868, and opened for the reception of students in September of the following year.

In addition to the seventy-two sections of land granted, the General Government also gave ten sections to the university for building purposes.

#### STATE APPROPRIATIONS.

By an act passed March 30, 1868, the State of California granted the sum of two hundred thousand dollars, which was to be realized from

<sup>1</sup> Report of Commissioner of Education, 1867-68, 125.

<sup>2</sup> See Wiley's History of College of California, chap. 17 and 18.



the sale of swamp lands located within the State; two years later we find an act recorded which provided for the sale of certain swamp lands to the amount of about eight hundred thousand dollars, or sufficient to yield an income of fifty thousand dollars, the principal of which was to remain as a perpetual university fund.<sup>1</sup>

In 1872 an appropriation of three hundred thousand dollars was made by the Legislature for a university building fund.<sup>2</sup> It was also provided in the same year, and approved March 26, 1872, that the deficiency expenses of the university should be paid out of the public treasury for the two years following, not to exceed six thousand dollars, per month.<sup>3</sup>

The appropriations during 1873-74 were for different purposes, and under the title 'aid for the university,' equal eighty-thousand dollars; of this sum, fifteen thousand dollars was for the Agricultural and Mechanical College. In addition to this, the sum of \$4,800 was given for the support of the library of the State University. Also by the same act the products of the surveys of the State Geologist were ordered to be delivered to the university and five thousand dollars devoted to the classification and arrangement of the same.<sup>4</sup>

A law deserving especial mention was that enacted in the session of 1873-74 prohibiting the sale of intoxicating liquors within two miles of the site of the university.<sup>5</sup>

For the two years of 1885 and 1886 the following appropriations were made:

|                                                                                                      |            |
|------------------------------------------------------------------------------------------------------|------------|
| Deficiency of the account of the Agricultural College.....                                           | \$350.57   |
| For the benefit of the university grounds and water supply.....                                      | 51,456.00  |
| For the benefit of the College of Agriculture.....                                                   | 23,500.00  |
| For viticulture, under joint control of the board of regents and the State Viticultural Society..... | 10,000.00  |
| College of Mechanical Engineering.....                                                               | 12,000.00  |
| School of Civil Engineering.....                                                                     | 2,500.00   |
| Observatory of Civil Engineering.....                                                                | 5,000.00   |
| College of Mines.....                                                                                | 10,000.00  |
| Department of geology.....                                                                           | 14,500.00  |
| Department of physics.....                                                                           | 6,784.00   |
| Laboratory.....                                                                                      | 10,000.00  |
| Total.....                                                                                           | 150,000.57 |

Of the above sums, only one half of each appropriation was to be used the first year, with the exception of the library fund, which was to be wholly expended the first year.

"An act appropriating twenty-five thousand dollars to be used conjointly with a like sum of twenty five thousand dollars donated by H. D. Bacon for the construction of a building to be erected on the State

<sup>1</sup> *Ibid.*, chap. 20, p. 167.

<sup>2</sup> *Laws of 1873-74*, chap. 463, p. 684.

<sup>3</sup> *Laws of 1872*, chap. 507, p. 747.

<sup>4</sup> *Ibid.*, chap. 13, p. 12.

<sup>5</sup> *Ibid.*, chap. 329, p. 554.

University grounds, in Alameda County, for a library and art gallery,<sup>71</sup> was approved in April, 1878.

In the same year an appropriation of ten thousand dollars was made for the benefit of the Mining College, and the same amount (\$10,000) was given to the Agricultural College. Also, it was ordered that the interest on the Hastings endowment fund, amounting to fourteen thousand dollars, should be paid.<sup>72</sup>

An act authorizing the planting of jute was passed in March, 1880, and the College of Agriculture was directed to plant not less than one nor more than five acres as an experiment,<sup>73</sup> for which necessary appropriation was to be made. In order to place the funds in better working condition, the Legislature, by an act approved March 19, 1878, formed the "Consolidated perpetual endowment fund of the University of California." The act reads as follows:

"SEC. 1. That the entire principal sums which have been or may be hereafter realized from several sources of income and endowment funds of the University of California, to wit, the principal sum derived from the sale of lands granted to the State of California by an act of Congress approved July 2, 1872, and amendments thereto, and the principal sum derived from the sale of seventy-two sections of land granted to the State of California for the use of a seminary of learning by act of Congress approved March 3, 1853, and the principal sum derived from the sale of ten sections of land granted to the State of California for the use of a seminary of learning by act of Congress approved March 3, 1853, and the principal sum which the treasurer of the State of California was directed by act of the Legislature approved April 2, 1870, to place to the account of the university fund, and which, being invested in the bonds of the State, should yield an income of fifty thousand dollars, and the principal sum now remaining on hand derived from the sale of the real estate in Oakland, Alameda County, and State of California, known as the Brayton property, shall be collected into a general fund and the interest only used."<sup>74</sup>

#### SOURCES OF ENDOWMENT.

Thus we have a review of the permanent university fund, or as it is given by Hittell<sup>75</sup> in a summary in the code.

#### *Sources of Endowment of the University of California.*

(1) The proceeds of the sale of seventy-two sections of land granted to the State for a seminary of learning.

<sup>71</sup> Laws of 1877-78, chap. 584, p. 939.

<sup>72</sup> Laws of 1877-78, chap. 673, p. 1088: Mr. Hastings, of San Francisco, gave one hundred thousand dollars to endow a law school, which became a branch of the university, and the State held the money in trust at this time.

<sup>73</sup> Hittell, *Annals to Code*, 1466.

<sup>74</sup> Laws of 1877-78, chap. 277, p. 337.

<sup>75</sup> Hittell, *Statutes*, sec. 1415.

(2) Proceeds of ten sections of land granted for the purpose of building.

(3) Income from investment made from the proceeds of the sale of public scrip for the teaching of agriculture and the mechanic arts.

(4) Endowment fund arising from the sale of swamp lands.

(5) Gifts and grants.

The Legislature, as will be seen, has from time to time made generous appropriations to the university.

By an act of 1883, approved March 1, the funds were placed under the exclusive control of the regents of the university.<sup>1</sup>

The board of regents numbers twenty-three, of whom the Governor, Lieutenant Governor, Superintendent of Public Instruction, Speaker of the Assembly, president of the State Agricultural Society, the president of the Mechanics' Institute, and the president of the university are *ex-officio* members of the board, and the remaining sixteen are appointed by the Governor. These regents are required to make full reports of their proceedings to the Legislature.

From the regents' report for the year 1885 is extracted the following statement, which shows the resources of the university. In addition to this the appropriations for the same year amounted to \$97,730 for the several departments. By this report the estimated available income for 1885 amounted to \$98,000.

#### FUNDS AND ENDOWMENTS.<sup>2</sup>

|                                                    |              |
|----------------------------------------------------|--------------|
| State endowment fund .....                         | \$-11,500.00 |
| United States endowment fund .....                 | 432,000.00   |
| Seminary land investment fund .....                | 19,000.00    |
| Land administration fund .....                     | 22,000.00    |
| Brayton fund .....                                 | 90,155.00    |
| Special investment fund .....                      | 20,000.00    |
| D. O. Mills' endowment philosophy .....            | 75,000.00    |
| Additional gift .....                              | 11,906.00    |
| Dyeston fund .....                                 | 79,750.00    |
| Reese's estate fund .....                          | 50,000.00    |
| University trust fund .....                        | 3,029.35     |
| Total .....                                        | 2,457.45     |
| Produce .....                                      | 1,515.42     |
| <hr/>                                              |              |
|                                                    | 1,675,386.25 |
| <hr/>                                              |              |
| University site of 277 acres, buildings, etc. .... | 1,000,000.00 |
| Horticultural endowment fund .....                 | 100,000.00   |
| University property .....                          | 700,000.00   |

The Thompson endowment consists of forty-seven acres of land now in 1885 rented for one hundred and seventy-five dollars per annum. As soon as the property reaches a value of fifty thousand dollars it is to be sold for the benefit of the university. In this report of 1885 the

<sup>1</sup> Laws of 1883, chap. 39, p. 51.

<sup>2</sup> Report of the board of regents, 1885, p. 7.

regents state, with reference to the seminary grant, that 45,034.86 acres of the entire 46,080 had already been selected, while the remaining 1,044.14 acres were yet to be applied for; of the 6,400 acres granted for building purposes, application was still to be made for 478.33, and of the one hundred and fifty thousand acres of agricultural land granted, 146,615 had been selected, leaving about 3,384.19 still to be located. The minimum price of the last grant was fixed at five dollars per acre, and the estimated value of the unsold grant was \$26,860.<sup>1</sup>

The last substantial work performed by the Legislature for the benefit of the university was the creation of a permanent endowment by levying a tax of one-tenth of a mill on each dollar of assessed valuation of property. The act providing for this tax reads thus:<sup>2</sup>

"SEC. 1. There is hereby levied, annually for each fiscal year, an 'ad valorem' tax of one per cent. upon each one hundred dollars of value of the taxable property of the State, which tax shall be collected by the several officers charged with the collection of State taxes, in the same manner and at the same time as other State taxes are collected, upon all or any class of property, which tax is for the support of the University of California.

"SEC. 2. The State Board of Equalization, at the time when it annually determines the rate of State taxes to be collected, must at the same time declare the levy of said rate of one cent, and notify the Auditor and Board of Supervisors of each county thereof.

"SEC. 3. The money collected from said rate, after deducting the proportionate share of expenses of collecting the same to which other State taxes are subject, must be paid into the State treasury, and to be by the State Treasurer converted into a separate fund, hereby created, to be called the 'State University Fund.'

"SEC. 4. The money paid into the said 'State University Fund' is hereby appropriated, without reference to fiscal years, for the use and support of the University of California, and is exempted from the provisions of part three, title one, article eighteen, of an act entitled 'An act to establish a political code,' approved March twelfth, eighteen hundred and seventy-two, relating to the Board of Examiners. When there is any money in the said fund, the same may be drawn out upon the order of the board of regents of the University of California, or such officers of the board as may be duly authorized thereto. Upon the receipt of the order, the Controller must draw his warrant upon the State Treasurer, payable to the order of the treasurer of the University of California, out of the said 'State University Fund.'

"SEC. 5. The money derived from said fund must be applied only to the support and permanent improvement of the university, and the board of regents must include in its biennial report to the Governor a statement of the manner, and for what purposes the money was expended.

<sup>1</sup> J. Haue's report (Land Ag. Univers. California), in Regents' Report, 1886, 120.

<sup>2</sup> Laws of California, extra Leg. session, 1877, chap. 3, p. 2.



representatives of the people so decided; they chose to devote it to the cause of higher education and to use the annual income for the support and maintenance of the State University. This swells the entire State appropriation to the sum of \$2,322,562.22.

APPROPRIATIONS BY THE STATE OF CALIFORNIA FOR THE USE OF THE UNIVERSITY.

Erecting and furnishing buildings:

|                    |              |                    |
|--------------------|--------------|--------------------|
| Apr. 1, 1872.....  | \$300,000.00 |                    |
| Apr. 3, 1876.....  | 40,000.00    |                    |
| Apr. 1, 1878.....  | 25,000.00    |                    |
| May 5, 1881.....   | 10,000.00    |                    |
| Mar. 9, 1883.....  | 2,500.00     |                    |
| Mar. 10, 1885..... | 2,500.00     |                    |
|                    |              | <hr/> \$380,000.00 |

*Apparatus.*

Mining department:

|                    |           |                 |
|--------------------|-----------|-----------------|
| Apr. 1, 1878.....  | 10,000.00 |                 |
| Apr. 16, 1880..... | 5,000.00  |                 |
| May 5, 1881.....   | 4,000.00  |                 |
| Mar. 9, 1883.....  | 8,000.00  |                 |
| Mar. 10, 1885..... | 10,000.00 |                 |
|                    |           | <hr/> 37,000.00 |

Mechanical department:

|                    |           |                 |
|--------------------|-----------|-----------------|
| Apr. 16, 1878..... | 5,000.00  |                 |
| May 5, 1881.....   | 4,000.00  |                 |
| Mar. 9, 1883.....  | 10,000.00 |                 |
| Mar. 10, 1885..... | 12,000.00 |                 |
|                    |           | <hr/> 31,000.00 |

Mineralogical department:

|                    |          |  |
|--------------------|----------|--|
| Apr. 16, 1880..... | 5,000.00 |  |
|--------------------|----------|--|

Physical laboratory:

|                   |          |  |
|-------------------|----------|--|
| Mar. 9, 1883..... | 5,500.00 |  |
|-------------------|----------|--|

Engineering department:

|                    |          |                |
|--------------------|----------|----------------|
| Mar. 9, 1883.....  | 5,000.00 |                |
| Mar. 10, 1885..... | 2,500.00 |                |
|                    |          | <hr/> 7,500.00 |

Observatory for civil engineer:

|                    |          |  |
|--------------------|----------|--|
| Mar. 10, 1885..... | 2,500.00 |  |
|--------------------|----------|--|

Department of physics:

|                    |          |  |
|--------------------|----------|--|
| Mar. 10, 1885..... | 6,784.00 |  |
|--------------------|----------|--|

Viticulture:

|                    |          |                 |
|--------------------|----------|-----------------|
| Apr. 16, 1880..... | 3,000.00 |                 |
| Mar. 9, 1883.....  | 2,000.00 |                 |
| Mar. 10, 1885..... | 5,000.00 |                 |
|                    |          | <hr/> 10,000.00 |

Agriculture:

|                    |           |                 |
|--------------------|-----------|-----------------|
| Mar. 30, 1874..... | 30,000.00 |                 |
| Apr. 1, 1875.....  | 10,000.00 |                 |
| Apr. 16, 1880..... | 5,000.00  |                 |
| May 3, 1881.....   | 10,000.00 |                 |
| Mar. 9, 1883.....  | 1,800.00  |                 |
| Mar. 9, 1883.....  | 15,000.00 |                 |
| Mar. 10, 1885..... | 359.79    |                 |
| Mar. 10, 1885..... | 23,500.00 |                 |
|                    |           | <hr/> 96,659.79 |

# UNIVERSITY OF OREGON.

|                                                                                |            |                    |
|--------------------------------------------------------------------------------|------------|--------------------|
| ary:                                                                           |            |                    |
| Mar. 30, 1874.....                                                             | \$4,800.00 |                    |
| Mar. 10, 1885.....                                                             | 10,000.00  |                    |
|                                                                                |            | <u>\$14,800.00</u> |
| logy and natural history, Mar. 10, 1885.....                                   |            | 18,500.00          |
| provement of grounds and buildings:                                            |            |                    |
| Mar. 9, 1884.....                                                              | 11,000.00  |                    |
| Mar. 10, 1885.....                                                             | 51,456.00  |                    |
|                                                                                |            | <u>62,456.00</u>   |
| upport of university, approved March 30, 1874.....                             |            | 50,000.00          |
| ncome from tax, 1 cent on each \$100, year ending June 30, 1888.....           |            | 82,543.43          |
|                                                                                |            | <u>809,843.22</u>  |
| Appropriated by Congress, for agricultural experiment stations, per annum..... |            | 15,000.00          |
| Proceeds from sale of land up to the first of April, 1889.....                 |            | 67,143.21          |

## OREGON.

### UNIVERSITY OF OREGON.

In 1850, two years after Oregon was organized as a Territory, the United States granted her two townships of land for the endowment of a university.<sup>1</sup> The first mention of the university upon Oregon's statute books is in the Laws of 1850, where Marysville is designated as its location.<sup>2</sup> In 1852 a commissioner was appointed to have charge of and to sell the university lands.<sup>3</sup> Three years later, the institution was relocated at Jacksonville.<sup>4</sup> So far, the university existed only on paper, and there it remained for some time, as the Constitution of 1857, after providing for the sale of university lands and the investment of the proceeds, directed that no part of the funds should be expended until 1867, unless the same should be otherwise disposed of for common school purposes. Evidently the settlers were not ready for the university. The disposal of the lands was further regulated by an act of 1868, ordering that all university lands should be sold, none, however, for less than one dollar and twenty-five cents an acre, and that payment be secured by notes bearing interest at ten per cent.<sup>5</sup>

The most important step toward establishing the university was in 1874, when its location was fixed at Eugene City, on condition that the Union University Association of that place should furnish a suitable building.<sup>6</sup> This society complied with the requirement, and an act of

<sup>1</sup> U. S. Statutes at Large, IX, 429.

<sup>2</sup> Laws of 1850.

<sup>3</sup> Laws of 1852, 517.

<sup>4</sup> Laws of 1855, 562.

<sup>5</sup> Article VIII, sec. 5, Poore, Charters and Constitutions, 152; Report of U.

State of Education for 1867-68, 121.

1876 fully established the university and pledged the interest on the university fund to it forever, besides granting it twenty thousand dollars additional endowment.<sup>1</sup> As over thirty thousand dollars of the fund had become unproductive "through ill-advised loans on the part of the State authorities," two thousand five hundred dollars was in 1878 annually set apart from the treasury for the support of the university.<sup>2</sup> In 1882 interest on the fund was reduced to eight per cent., and an annual tax of one-tenth of a mill on the dollar was laid on all property taxable for State purposes. Of the proceeds of this, five thousand dollars was set apart annually for the support of the university, the remainder to be used for buildings and improvements.<sup>3</sup> Besides this tax and the income on the fund, the university has received fifty thousand dollars from the State.

## CORVALLIS COLLEGE.

The Congressional land grant of 1862 gave to Oregon ninety thousand acres.<sup>4</sup> In the same year the Legislature accepted the land and appointed commissioners to locate the agricultural college.<sup>5</sup> In 1870 Corvallis College was designated as the recipient of the grant.<sup>6</sup> The lands were disposed of by an act of 1872, which provided that they should be sold for not less than two dollars and fifty cents an acre, and that the proceeds should be loaned on mortgages at ten per cent.,<sup>7</sup> reduced to eight per cent. in 1882.<sup>8</sup> The additional appropriations received from the State amounted, in 1887, to twenty thousand five hundred dollars.<sup>9</sup>

## SUMMARY.

While public aid to higher education came first from the Federal Government, Oregon herself has not withheld assistance. Besides the university tax of one-tenth of a mill on every dollar of taxable property, seventy thousand five hundred dollars have been granted, fifty thousand dollars to the State university and twenty thousand five hundred dollars to Corvallis College.

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<sup>1</sup> Laws of 1872, 10.    Laws of 1876, 52.

<sup>2</sup> Laws of 1878, 57.

<sup>3</sup> Laws of 1882, 5, 9.    Catalogue of 1885-86, 17.

<sup>4</sup> General Laws of 1862, 63.

<sup>5</sup> *Ibid.*, 1863, 109.

<sup>6</sup> Laws of 1870, 17.

<sup>7</sup> Laws of 1872, 133.

<sup>8</sup> Laws of 1882, 9.

<sup>9</sup> Report of Commissioner of Education for 1886-87, 710.



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## APPENDIX A.

### HISTORICAL VIEW OF STATE EDUCATION IN THE OLD WORLD.

State education is found among the oldest institutions of history. It has been established in some form by nearly all of the nations of the earth, and at all times the status of education has been determined by the political condition of a country. A high state of culture can not long remain independent of and separate from the institution of political government, for it will be either crushed by the arm of despotism or, rising in its own activity, it will transform the government into a protecting power. It is safe to say that under the benign influence of political protection the highest literary development has been attained, while the best products of culture have flowed through political channels. It is now democratic Athens, now imperial Rome, now royal France, now constitutional England that fosters and protects higher learning. This government aid to education may be seen in the patronizing whims of princes, in the recognition of individual merit. It may be seen in the wise provision of beneficent laws for the protection of independent effort, or again in a strong national policy for the protection of art, literature, and science. The great universities of ancient and modern times have received government support. The Academy at Athens and the Universities of Alexandria and Rome testify to the truth of this assertion; let Bologna and Paris, Pisa and Salamanca, Oxford and Wittenberg, Leyden and Berlin, bear witness to the fostering care of the respective governments under which they have existed. The great libraries of the world have been the creations of government. The ancient libraries of Assyria and Egypt, and the modern collections of the Vatican, of London, of Paris, Berlin, and St. Petersburg were established and supported by governments.

Something more than a desire for personal glory and the perpetuation of a name must have filled the mind of the great Assur-bani-pal to induce him to collect the ancient and modern writings of his time and form them into a great library to be used as a basis for national education. He brought together the lore of the Chaldeans and of the ancient Accadians whose language was still used in worship. He provided for the education of the priests<sup>1</sup> and the scribes, and the interpreters of the law. He turned one part of his great palace into a

<sup>1</sup> Ragozin, Chaldaea, 106.

school of learning. The books of the library were arranged and classified; there were books on history, religion, and the natural sciences; on astronomy, grammar, legends of gods and men, and the laws and customs of the people. The remains<sup>1</sup> alone of the library of Ninevah<sup>2</sup> form a mass of more than one hundred cubic meters; the number of tablets surpasses ten thousand, and their contents would cover in the ordinary form of our present books more than five hundred quarto volumes of five hundred pages each. By this educational zeal of the great monarch, writings have been transmitted through thousands of years and their copies are now imperishable.

Alexandria for over six hundred years was the abode of men of learning. Here arose under the Ptolemies, in the third century before Christ, a complete system of higher education and libraries such as the world had never known before. Here was the first great university in the modern conception of the term. The Serapeum dates from 298 B. C. and disappears about 640 A. D. In connection with this great library, Ptolemy founded a college, or what might be called a *Studio Generale*, and endowed its professors. This college<sup>3</sup> was in the vicinity of the Serapeum, the Gymnasium, the royal palace, and the amphitheater. "A noble portico stretched along its front for exercise or conversation and opened on the public rooms devoted to disputation and lectures, a certain number of professors were lodged within the precincts, and a handsome hall or refectory was provided for the common meal." This building was called the Museum;<sup>4</sup> as time passed, other colleges were added and eminent men called to fill their chairs. The influence of this university was felt in Greece and Rome and subsequently throughout Europe; mathematics, law, astronomy, and other arts and sciences were cultivated.

The education of Sparta was wholly of the state and for the state; although education in letters and philosophy did not reach so high a standard as in Athens, the best was by the state. The academy at Athens, though nourished by beneficent influences, was not supported by the government during its earlier years. Its organization was entirely of a voluntary character. But when it was under the empire of Rome, the great emperors endowed it. Perhaps before Augustus, but certainly in the time of Marcus Aurelius, it received endowments from the imperial government. But these were only a partial endowment.<sup>5</sup> There were three principal chairs: rhetoric, philosophy, and politics. The first was recognized as the chief chair, and was endowed with the equivalent of two thousand five hundred dollars. To this school flocked the youth from Italy and the provinces of the empire to receive the highest intellectual training that could be given at that time. Athens

<sup>1</sup> *Mémoires de l'Académie de Nivee*.

<sup>2</sup> *Ibid.*

<sup>3</sup> *The History and Constitution of Universities*, Laurie, 5.

<sup>4</sup> *Ibid.*

<sup>5</sup> *The Office and Work of Universities*, 144, by J. H. Newman.

<sup>6</sup> *Ibid.*, 10.

long continued to be the great center of learning, but after the removal of the seat of the Roman empire to Constantinople, the latter city began to assume prominence in this respect.

Constantine the Great encouraged learning, and many of his successors<sup>1</sup> endowed institutions. Theodosius and Valentinian developed more fully the scheme of construction, and organized the teaching at the Eastern capital by appointing a complete corps of professors. The influence of the Christian religion was fast undermining the Romano-Hellenic schools. "Family education became a more influential feature in society than public instruction; and though family education from the fourth to the seventh century appears to have improved the morality of the population, it certainly increased their superstition and limited their understandings." Bordas tried to revive the flagging interest.<sup>2</sup> About 850 A. D., he founded a free university at Constantinople, making it independent of the church and the clergy, and gave it a constitution. Distinguished teachers were appointed in philosophy, rhetoric, geometry, and astronomy; also special teachers in the sciences were paid out of the public treasury. The philosopher Leo<sup>3</sup> had the direction of the entire system of education. But it was not until the reign of the Macedonian dynasty which began in 867 A. D. that the Byzantine empire entered upon its most brilliant period. Subsequently Constantino Porphyrogenitos (913-954) established four schools of science, and required that all the officers in the government of a higher grade should be filled from members of this school who were well versed in rhetoric and philosophy. In the face of all these efforts, politics and learning declined, from inevitable causes.<sup>4</sup>

At Rome the university originated under Vespasian (64-79 A. D.), who instituted a "basilica" in his "Temple of Peace" where the learned might carry on their disputations. This was afterward enlarged under Hadrian (117-138 A. D.), and called the Athenæum. From the time of Vespasian fixed salaries and senatorial rank were attached to certain chairs in the Athenæum. The object of this State education, says Merivale, was to "restore the tone of society and infuse into the national mind healthier sentiments,"<sup>5</sup> and in speaking of education under the Caesars, Gibbon says, "In all the cities of the Roman world the educa-

<sup>1</sup> Mitford, *History of Greece*, 282.

<sup>2</sup> Finlay, *History of Greece (Byzantine)*, I, 5.

<sup>3</sup> Newman, 6.

<sup>4</sup> It is not easy to state the causes; yet as a fact from the time that the state took hold of learning to organize it in Greece, the enthusiasm for learning and the love of pure science gradually died out. It may have been a decline in government. Possibly the students were of a different class and came to prepare for offices in the state. Conrad holds that in the German universities young men attend largely as a pecuniary matter, for the purpose of preparing for employment, and this has a tendency to lower the ideas of learning. (See Conrad's *German Universities*.)

<sup>5</sup> Merivale's *History of Rome*, Vol. VII, p. 29.

tion of youth was intrusted to masters of grammar and rhetoric who were supported at public expense, and distinguished by many lucrative and honorable privileges."<sup>1</sup> This was in the days of the empire; for in earlier history the education of youth was a purely private matter, dominated neither by the State nor by religion. At the university of Rome in 1514, the professors numbered one hundred, and their salaries were paid by the government. These few citations will indicate the movement toward higher education under the directions of the old nations of the earth. The next educational movement that breaks forth in western Europe has been greatly modified by Christianity. Charles the Great, though a strong defender of the Faith, was the first in the modern world to establish state schools. Nothing is more noted in history than the civil, political, and religious reforms of Charles the Great in the revived Roman empire during the latter part of the eighth century.

When the great emperor came to the throne he soon perceived that the proposed reforms would prove wholly impracticable unless the illiteracy of the priests and the general ignorance of his subjects could be diminished by proper education. He, therefore, set himself at once to the task of reforming the schools of the realm. The episcopal and monastery schools were improved, and the priests<sup>2</sup> were instructed to give more diligent application to religious studies and at the same time special attention to literature.<sup>3</sup> The ablest scholars of that time were invited to the imperial court, among whom Leidrade, of Noricum, and Alcuin, of York, were the most celebrated. After reforming the monasteries, Charles turned his attention to founding a system of free schools<sup>4</sup> in the towns throughout the empire, and especially<sup>5</sup> to the founding of the famous Palatine school.<sup>6</sup> The latter was especially designed for the education of the government officials and their children, but was free to all who desired learning. The remarkable feature of this school was that all persons who became proficient in studies or distinguished themselves as scholars, however humble their origin or circumstances, were promoted in the service of the state. Here then was a state school with a system of civil service reform attached; a civil academy for the benefit of the state. Charles did not stop here, but extended the free school system throughout the empire; without doubt he was the first originator of parish or district schools.

In the extension of the school system throughout the realm, three cities, Ravenna, Paris, and Bologna received especial privileges and be-

<sup>1</sup> Guizot, *l. c.*, II, chap. 22, p. 154.

<sup>2</sup> Letter to the Bishops, in Balguy, *Antiquit. Capit. Archa. Regum Francorum*, Vol. I, pp. 301-304 (Paris).

<sup>3</sup> "Episcopis et clericis studium pietatis adhibere."

<sup>4</sup> *M. l. c.*, chap. 197.

<sup>5</sup> The abbot, Bishop of Orleans, succeeded Alcuin and became minister of education. It is through his letters that evidence of these schools are in existence.

<sup>6</sup> Müllinger, *The Schools of Charles the Great*, p. 41 et seq.

came educational centres. Their public schools were of high grade. It is claimed by some that Charles had in mind the building of great universities at these places, after the manner of those at Athens and Alexandria. However, this is merely supposition, although as a result of the schools at these places great universities did spring up; not in the relation of cause and effect, for long centuries of misrule had obliterated Charles' educational foundations and left barely the marks of civic progress. But these marks of progress in the centres of wealth, industry, and historic interest rendered these places desirable points for the congregation of students. "And whether his school at Paris be called a university or not, he laid principles of which a university is a result in that he aimed to educate all classes, and undertook all subjects of teaching." In these municipal centres<sup>1</sup> were formed the early universities by the concourse of students. These universities had a natural development; it is not possible to say they were the product of the church or of the state. Perhaps the greatest organized influence came from the Cathedral and Benedictine schools coupled with Saracenic influences. But there sprung up with these schools of special learning an anti-monastic spirit, and each school drew students according to its specialty, law at Bologna, medicine at Salerno, and philosophy and theology at Paris.

One remarkable fact is that the education of the clergy and the laity, church education and civil education, were both in the hands of the state, that is, in those of the emperor. The first charter of the University of Paris was granted by Philip Augustus in 1199; this exempted its members from the ordinary tribunals and from the tribunals of the church.<sup>2</sup> The University of Bologna, though not older than Paris, was chartered with the same privileges in 1158 by Frederick I (Barbarossa). Frederick II, Emperor of the Romans, founded the University of Naples. The sovereign power called certain masters or doctors to act as professors, to some if not to all of whom he granted salaries. The university was founded by the state solely and under the control of the sovereign, while the professors were freed from taxes and from military service, and had other immunities granted them.<sup>3</sup>

Students prepared in these universities of Italy for high offices in church and in state. "From this time," says Hallam, speaking of the first charters, "the golden age of universities commenced; and it is hard to say whether they were favored more by their sovereigns than by the see of Rome." However, this is immaterial as the rules then were, whether civil or ecclesiastical, the state, and the benefactions of popes and kings came from the public treasury, and primarily from the people. Whether the great universities of Paris, and Bologna, Oxford,

<sup>1</sup> See also, *The Origin and Work of Universities*, 239.

<sup>2</sup> Hallam's *Middle Ages*, II, 420.

<sup>3</sup> Laurie, *Rise and Constitution of Universities*, 120.

Pavia, and Prague and others were endowed by kings or princes, bishops or popes, the funds came from the masses of the people.<sup>1</sup>

The great universities of England were patronized by kings, although their modern support has been from private rather than public sources. It is thought that the learned Alfred founded a school at Oxford and made it a centre of learning; but it is known that Oxford was chartered with privileges by King John<sup>2</sup> in the thirteenth century. Subsequently the universities secured favors and royal patronage from the Henrys and the Edwards.<sup>3</sup> They have grown to be national in their character, and through their great public influence and modern university extension are rapidly becoming popular institutions in the best sense of the term. Cambridge was founded "for the study of learning and knowledge and for the better service of church and state," while Oxford, London, and others have filled the same office. The incomes of Oxford and Cambridge for the year 1887 were £256,175 and £346,550, respectively.<sup>4</sup> In the year 1874 Great Britain appropriated for her universities £52,027.

The University of Leyden, so often referred to as the product of the self-sacrifice of a noble people, was created and endowed by the Dutch Republic. It was granted as a reward to the people of Leyden for their heroic defence of their city against the crafty Spaniards in the darkest hours of their national struggle (1575).

The most complete state system of schools of modern times is found in Germany. As early as 1794 the common law of the Prussian states declared schools and universities to be state institutions, and set up a system of laws controlling the whole plan of instruction.<sup>5</sup> In the development of modern Germany the growth of the public school system has kept abreast of every reform, and has been one of the strongest forces for the rebuilding of the nation. Later, when Prussia was humbled by the cruel tyranny of Napoleon, her army destroyed, industries suppressed, country depopulated by war, and devastated by the ruthless track of the invader, the memorable words of the King, William III, were prophetic of the future of United Germany: "Although we have lost territory, power, and prestige, still we must strive to regain what we have lost by acquiring intellectual and moral power; and, therefore, it is my earnest desire and will to re-establish the nation by devoting a most earnest attention to the education of the masses of the people."  
• • • • The state must regain in mental force what it has lost in physical force."<sup>6</sup>

<sup>1</sup> See A. A. Davis, Washington, and the Higher Education. H. B. Adams, *The State and Higher Education*. A. A. Davis, Department of Superintendence of the National Education Association, Washington, March 8, 1879.

<sup>2</sup> *Ibid.*, p. 127.

<sup>3</sup> *Journal of the History of Oxford*, Lege, Oxford, in 1836.

<sup>4</sup> *Washington's Annals*, 1879.

<sup>5</sup> *Prussian Instruction in Prussia*, Barnard, *Secondary Schools*.

<sup>6</sup> *Proclamation of Frederick William III*, 1807.

Behind this sentiment were strong men and philosophers who saw on what hung the destiny of Germany. Fichte proclaimed that "Education is the only means by which we can be rescued from our helpless condition." • • • "I hope to convince Germans that nothing but education can rescue us from the miseries that overwhelm us." • • • "Education as hitherto conducted by the church has aimed only at securing for men happiness in another life; but this was not enough, for men need to be taught how to bear themselves in the present life so as to do their duty to the state, to others, and themselves."<sup>1</sup> Fichte touched the vulnerable point of the mediæval education. There soon came into being a great university, situated at the seat of the government of the kingdom. Berlin has the greatest direct power of all the universities in Europe. It brings together yearly more than five thousand students from the empire. In 1874 the government of Prussia appropriated \$242,054.80 for the support of the University of Berlin. Of the entire income of the Prussian universities in 1883-84, amounting to 8,103,000 marks, 613,000 were contributed by the state.<sup>2</sup> It is true that the University of Berlin, though differing from all others in some particulars, was a part of a great system of which the University of Prague was the first in Germany; and, indeed, it was the first formally-founded university in Europe, if we except Naples and Palencia.<sup>3</sup>

Prague was founded by Charles IV, in 1348, and embraced a *studium generale* of all the faculties. It was not founded like Berlin in response to a national demand, but after the idea of Charles IV who, having been educated at Paris, returned to set up a university in his own realm, after obtaining a bull from the pope.<sup>4</sup> Indeed, the whole course of mediæval universities shows the pope to be the universal arbiter on questions of difficulty, whether he had founded the universities or not. Charles IV appointed the Archbishop of Prague chancellor, and called from different parts of the educated world learned professors in the several departments, giving endowments for their support. Other universities followed, endowed by the state or the church, until now no less than twenty-one, patterned more or less after the original design of the first, are distributed over Germany, calling to their halls many of the brightest students of the empire and of other countries.

In this brief review of state education in the Old World, we may learn that the present forms of education as we have known them in the United States are not new creations, but have had their prototypes in

<sup>1</sup> C. K. Adams' Address.

<sup>2</sup> Roeder, Finanzwissenschaft, p. 592 (Ed. 1886). In 1875-76 Prussia expended \$14,329,320 for education; in the following year the sum of \$15,186,133. In the same years France expended for higher education \$2,317,917 and \$2,290,454, respectively.

<sup>3</sup> Laurie, 256; the university at Palencia, Spain, was founded in 1212 by Alonzo VIII, with privileges and benefactions.

<sup>4</sup> From this time to the Reformation every university founded had two charters, one from the pope and the other from the king or emperor.



**Old World institutions.** The mediæval college was not destroyed by the rising of universities, but was incorporated in their more general organization and handed down to us at the present, modified to suit the growth of knowledge. The modern academy, the primary school, the parish school, or county school, the college and the university are but evolutions in the United States, suited more or less to our express needs.

We have seen that at times schools were wholly independent of either ecclesiastical or political patronage; at other times they were controlled and supported by the church or state, separately or conjointly; and, again, the church has controlled the education of both clergy and laity; or this comprehensive duty has fallen upon the State. Our modern college has sprung from the mediæval college through the "great schools" of England. One type of our universities, such as that of Virginia, has some resemblance to the University of Paris, while Harvard and Yale are following in the paths of Cambridge and Oxford.

The influence of the German universities has been more perceptible during recent years. The University of Michigan was planned after German or rather Prussian models. There was a magnificent scheme for a central university, colleges, and high schools, all controlled by one central authority. This idea has had more or less influence in the formation of the systems of education in the new States of the West. The chief German influence is felt in methods of study and discipline, and new features of school curricula; this is more to be observed in the lowest grade, the kindergarten, and in the highest grade, the university, than in other departments. Have we universities in America? Yes, American universities, not like some in the Old World, but universities that are developing with the country and the nation. While there is much to learn and great room for improvement, let it be remembered by those who disparage the American universities in comparison with foundations of seven hundred years' standing, that but one attempt was ever made to import a European university<sup>1</sup> into America, and that failed.\*

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<sup>1</sup> James Smith to import the faculty of Geneva. See H. B. Adams' *William and Mary College*, and his *Thomas Jefferson and the University of Virginia*.

## APPENDIX B.

**TABLE I.—Statistics relating to State Colleges and Universities, showing State Endowments, Appropriations, etc.**

[Columns one, two, and three mostly compiled from the Report of the Commissioner of Education, 1886-87.]

| Name of State.      | Value of Gro. Inds. Build-<br>ing's, Apparatus, etc.—<br>Unproductive Prop-<br>erty. | Value of Endowments—<br>Productive Property. | Annual Income from Pro-<br>ductive Funds. | Permanent State Endow-<br>ment. | Income from Permanent<br>State Endowment. | Total State Appropria-<br>tions for Higher Edu-<br>cation. | Amount of Assessed<br>Valuation of Property. | Population in 1880. |
|---------------------|--------------------------------------------------------------------------------------|----------------------------------------------|-------------------------------------------|---------------------------------|-------------------------------------------|------------------------------------------------------------|----------------------------------------------|---------------------|
| Alabama.....        | \$605,000                                                                            | \$551,500                                    | \$45,000                                  |                                 |                                           | \$279,750                                                  | \$214,925,869                                | 1,262,845           |
| Arkansas.....       | 500,000                                                                              | 130,000                                      | 10,400                                    |                                 |                                           | 257,894                                                    | 120,820,394                                  | 802,525             |
| California.....     | 750,000                                                                              | 750,000                                      |                                           | \$50,000 and 1 mill tax.        | \$128,648                                 | 22,468,331                                                 | 1,012,153,832                                | 864,634             |
| Colorado.....       | 171,512                                                                              | 62,000                                       | 7,700                                     | 2 mill tax.                     |                                           | 891,388                                                    | 130,000,000                                  | 184,327             |
| Connecticut.....    |                                                                                      | 135,000                                      |                                           | 2 mill tax.                     |                                           | 284,676                                                    | 348,774,879                                  | 622,700             |
| North Dakota.....   | 312,701                                                                              |                                              |                                           |                                 |                                           | 143,030                                                    | 157,084,360                                  | 135,177             |
| South Dakota.....   |                                                                                      |                                              |                                           |                                 |                                           |                                                            |                                              |                     |
| Delaware.....       | 50,000                                                                               | 83,000                                       | 4,780                                     |                                 |                                           | 116,000                                                    | (1)                                          | 110,808             |
| Florida.....        | 50,000                                                                               | 151,000                                      | 9,225                                     |                                 |                                           | 30,750                                                     | 76,611,409                                   | 280,493             |
| Georgia.....        | 288,000                                                                              | 455,202                                      | 43,564                                    |                                 |                                           | 983,181                                                    | 329,480,505                                  | 1,542,180           |
| Illinois.....       | 515,000                                                                              | 450,000                                      | 26,314                                    |                                 |                                           | 531,000                                                    | 797,773,002                                  | 1,677,871           |
| Indiana.....        | 550,000                                                                              | 500,000                                      | 30,000                                    | 25,000                          | 23,000                                    | 1,453,000                                                  | 791,536,079                                  | 1,978,301           |
| Iowa.....           | 760,000                                                                              | 115,037                                      | 62,905                                    | 20,000                          | 20,000                                    | 1,451,008                                                  | 501,379,744                                  | 1,624,615           |
| Kansas.....         | 720,508                                                                              | 674,786                                      | 41,238                                    |                                 |                                           | 922,606                                                    | 319,871,516                                  | 960,096             |
| Kentucky.....       | 100,000                                                                              | 165,000                                      | 9,200                                     | 2 mill tax.                     | 24,000                                    | 192,000                                                    | 517,214,301                                  | 1,618,680           |
| Louisiana.....      |                                                                                      | 318,313                                      | 13,244                                    |                                 |                                           | 794,300                                                    | 212,725,461                                  | 660,946             |
| Maine.....          | 165,000                                                                              | 230,300                                      | 11,500                                    |                                 |                                           | 313,718                                                    | 265,978,716                                  | 618,936             |
| Maryland.....       | 100,000                                                                              | 112,080                                      | 6,431                                     |                                 |                                           | 716,997                                                    | 485,839,772                                  | 934,943             |
| Massachusetts.....  | 964,800                                                                              | 652,575                                      | 34,431                                    |                                 |                                           | 1,761,088                                                  | 1,847,531,122                                | 1,783,085           |
| Michigan.....       | 1,355,851                                                                            | 970,720                                      | 50,502                                    |                                 |                                           | 2,105,908                                                  | 915,450,000                                  | 1,630,917           |
| Minnesota.....      | 1,000,000                                                                            | 750,000                                      | 40,000                                    | 40,000                          | 40,000                                    | 583,000                                                    | 469,831,464                                  | 780,773             |
| Mississippi.....    | 400,000                                                                              | 756,211                                      | 43,251                                    |                                 |                                           | 1,714,372                                                  | 122,736,808                                  | 1,181,507           |
| Missouri.....       | 125,000                                                                              | 72,000                                       | 3,600                                     |                                 |                                           |                                                            | 725,775,250                                  | 2,166,360           |
| Montana.....        |                                                                                      |                                              |                                           |                                 |                                           | (1)                                                        | 60,000,000                                   | 39,159              |
| Nebraska.....       | 250,000                                                                              |                                              |                                           | 2 mill tax.                     | 110,179                                   | 106,145                                                    | 160,700,266                                  | 452,402             |
| Nevada.....         | 25,000                                                                               | 135,471                                      |                                           |                                 |                                           | 135,471                                                    | 34,936,210                                   | 62,266              |
| New Hampshire.....  |                                                                                      | 100,000                                      |                                           |                                 |                                           | 106,904                                                    | 231,676,265                                  | 340,091             |
| New Jersey.....     |                                                                                      | 116,000                                      |                                           |                                 |                                           | 0                                                          | 573,256,394                                  | 1,131,116           |
| New York.....       | 6,000,000                                                                            |                                              |                                           |                                 |                                           | 820,241                                                    | 3,224,682,345                                | 5,004,871           |
| North Carolina..... | 288,500                                                                              | 135,000                                      | 7,800                                     | 20,000                          | 20,000                                    | 315,500                                                    | 205,712,622                                  | 1,099,750           |
| Ohio.....           | 850,000                                                                              | 507,041                                      | 32,250                                    |                                 |                                           | 261,504                                                    | 1,688,656,108                                | 1,198,062           |
| Oregon.....         | 475,000                                                                              | 420,000                                      | 60,000                                    | 2 mill tax.                     |                                           | 70,000                                                     | 77,188,091                                   | 174,768             |
| Pennsylvania.....   | 400,000                                                                              | 500,000                                      | 30,000                                    |                                 |                                           | 1,008,947                                                  | 1,006,016,954                                | 1,808,891           |
| Rhode Island.....   |                                                                                      | 75,000                                       |                                           |                                 |                                           | 0                                                          | 328,500,559                                  | 276,781             |
| South Carolina..... | 400,000                                                                              | \$95,750                                     | \$5,750                                   |                                 |                                           | 2,820,360                                                  | 119,971,305                                  | 905,777             |
| Tennessee.....      |                                                                                      | 100,000                                      | 24,500                                    |                                 |                                           | (1)                                                        | 276,456,761                                  | 1,512,159           |
| Texas.....          |                                                                                      | 850,000                                      | 50,000                                    |                                 |                                           | 302,407                                                    | 562,100,220                                  | 1,001,749           |
| Vermont.....        |                                                                                      | 123,626                                      |                                           |                                 |                                           | 90,500                                                     | 107,194,260                                  | 107,266             |
| Virginia.....       |                                                                                      | 701,912                                      | 41,225                                    |                                 |                                           | 2,135,675                                                  | 675,641,081                                  | 1,502,505           |
| Washington.....     |                                                                                      |                                              |                                           |                                 |                                           | (1)                                                        | 50,213,081                                   | 77,110              |
| West Virginia.....  |                                                                                      | 107,000                                      | 6,000                                     |                                 |                                           | 178,902                                                    | 15,399,700                                   | 608,400             |
| Wisconsin.....      | 1,000,000                                                                            | 28,618                                       | 12,600                                    | 2 mill tax.                     |                                           | 1,260,377                                                  | 58,120,741                                   | 1,515,690           |

<sup>1</sup> Land-ship fund.

<sup>2</sup> Approximate.

<sup>3</sup> Alcorn Agricultural College, not reported.

<sup>4</sup> State Agricultural College, not reported.

<sup>5</sup> Clallam University, not reported.

TABLE II.—UNIVERSITY LAND GRANTS.<sup>1</sup>

The following statement shows the number of acres granted to the States and reserved in the Territories of Washington, New Mexico, and Utah, for university purposes, by acts of Congress, the dates of which are given in proper column:

*Grants and Reservations for Universities.*

| States and Territories | Total area | Under what acts.                               |
|------------------------|------------|------------------------------------------------|
| <i>Acres</i>           |            |                                                |
| Ohio                   | 69,120     | April 21, 1792; March 3, 1803                  |
| Indiana                | 46,080     | April 19, 1816; March 3, 1803                  |
| Illinois               | 46,080     | March 26, 1804; April 18, 1818                 |
| Missouri               | 46,080     | February 17, 1818; March 6, 1820               |
| Alabama                | 46,080     | April 20, 1818; March 2, 1819                  |
| Mississippi            | 46,080     | March 3, 1803; February 20, 1819               |
| Louisiana              | 46,080     | April 1, 1806; March 3, 1811; March 3, 1827    |
| Michigan               | 46,080     | June 23, 1836                                  |
| Arkansas               | 46,080     | Do                                             |
| Florida                | 92,160     | March 3, 1845                                  |
| Iowa                   | 46,080     | Do                                             |
| Wisconsin              | 92,160     | August 6, 1846; December 15, 1854              |
| California             | 46,080     | March 3, 1853                                  |
| Minnesota              | 82,640     | March 2, 1861; February 26, 1857; July 6, 1870 |
| Oregon                 | 46,080     | February 14, 1859; March 2, 1861               |
| Kansas                 | 46,080     | January 29, 1861                               |
| Nevada                 | 46,080     | July 4, 1860                                   |
| Nebraska               | 46,080     | April 19, 1864                                 |
| Colorado               | 46,080     | March 3, 1875                                  |
| Washington             | 46,080     | July 17, 1854; March 16, 1864                  |
| North Dakota           | 46,080     | February 19, 1861                              |
| South Dakota           | 46,080     | Do                                             |
| Montana                | 46,080     | Do                                             |
| Arizona Territory      | 46,080     | Do                                             |
| Idaho Territory        | 46,080     | Do                                             |
| Wyoming Territory      | 46,080     | Do                                             |
| New Mexico Territory   | 46,080     | July 21, 1854                                  |
| Utah Territory         | 46,080     | February 21, 1855                              |
| Total                  | 1,136,960  |                                                |

TABLE III.—AGRICULTURAL AND MECHANICAL COLLEGE GRANTS.

States listed, and subject to selection, "in place," under act of July 2, 1862, and acts amendatory thereof.

|            | Acres   |                                            | Acres.    |
|------------|---------|--------------------------------------------|-----------|
| Washington | 240,000 | Nevada (also under act of July 2, 1862)    | 90,000    |
| Iowa       | 240,000 | Missouri                                   | 330,000   |
| Oregon     | 90,000  | Nebraska (also under act of July 23, 1860) | 90,000    |
| Kansas     | 90,000  | Colorado                                   | 90,000    |
| Minnesota  | 120,000 | Total                                      | 1,770,000 |
| Montana    | 240,000 |                                            |           |
| California | 150,000 |                                            |           |

<sup>1</sup> See "Public Domain," House Mis. Doc. 45, part 4, Forty-seventh Congress, second session.

*States to which scrip was issued, and amount.*

|                     | Acres.  |                            | Acres.    |
|---------------------|---------|----------------------------|-----------|
| Rhode Island .....  | 120,000 | Ohio .....                 | 680,000   |
| Illinois .....      | 480,000 | West Virginia .....        | 150,000   |
| Kentucky .....      | 330,000 | Indiana .....              | 320,000   |
| Vermont .....       | 150,000 | North Carolina .....       | 270,000   |
| New York .....      | 990,000 | Louisiana .....            | 210,000   |
| Pennsylvania .....  | 780,000 | Alabama .....              | 240,000   |
| New Jersey .....    | 210,000 | Arkansas .....             | 150,000   |
| New Hampshire ..... | 150,000 | South Carolina .....       | 180,000   |
| Connecticut .....   | 180,000 | Texas .....                | 180,000   |
| Massachusetts ..... | 300,000 | Georgia .....              | 270,000   |
| Maine .....         | 210,000 | Mississippi .....          | 210,000   |
| Maryland .....      | 210,000 | Florida .....              | 90,000    |
| Virginia .....      | 300,000 |                            |           |
| Tennessee .....     | 300,000 | Total .....                | 7,830,000 |
| Delaware .....      | 90,000  | Total in place and scrip.. | 9,600,000 |

TABLE IV.—AGRICULTURAL COLLEGES.

The following statement shows the names and locations of agricultural colleges, with the number of acres of scrip or land in place given to the several States and the amounts realized therefrom:

*Agricultural colleges located by the several States under the act of July 2, 1862.*

| Name and location.                                                                         | Amount derived from sale of United States land or scrip. | Number of acres received from the United States. |
|--------------------------------------------------------------------------------------------|----------------------------------------------------------|--------------------------------------------------|
| Agricultural and Mechanical College of Alabama, Auburn, Ala.....                           | \$216,000                                                | 240,000, scrip.                                  |
| Arkansas Industrial University, Fayetteville, Ark.....                                     | 135,000                                                  | 150,000, scrip.                                  |
| University of California, Berkeley, Cal.....                                               | 750,000                                                  | 150,000, place.                                  |
| Agricultural College of Colorado, Fort Collins, Colo.....                                  | 270,000                                                  | 90,000, place.                                   |
| Sheffield Scientific School of Yale College, New Haven, Conn.....                          | 135,000                                                  | 180,000, scrip.                                  |
| Delaware College, Newark, Del.....                                                         | 83,000                                                   | 90,000, scrip.                                   |
| State Agricultural College, Eau Gallie, Fla. <sup>1</sup> .....                            | 110,806                                                  | 90,000, scrip.                                   |
| Georgia State College of Agriculture and the Mechanic Arts, Athens, Ga. <sup>2</sup> ..... | 243,000                                                  |                                                  |
| North Georgia Agricultural College, Dahlonega, Ga. <sup>3</sup> .....                      |                                                          | 270,000, scrip.                                  |
| Illinois Industrial University, Urbana, Ill.....                                           | 319,491                                                  | 480,000, scrip.                                  |
| Purdue University, La Fayette, Ind.....                                                    | 212,228                                                  | 390,000, scrip.                                  |
| Iowa State Agricultural College, Ames, Iowa.....                                           | 500,000                                                  | 210,000, place.                                  |
| Kansas State Agricultural College, Manhattan, Kans.....                                    | 290,000                                                  | 90,000, place.                                   |
| Agricultural and Mechanical College of Kentucky, Lexington, Ky.....                        | 163,000                                                  | 330,000, scrip.                                  |
| Louisiana State Agricultural and Mechanical College, Baton Rouge, La.....                  | 627,000                                                  | 210,000, scrip.                                  |

<sup>1</sup> Congressional grant of ninety thousand acres not yet in the market.<sup>2</sup> Estimated, unsold 1867.<sup>3</sup> Location questionable; college not yet organized.<sup>4</sup> Department of University of Georgia.<sup>5</sup> Receives annually from University of Georgia three thousand five hundred dollars, part interest land-scrip fund.<sup>6</sup> Three hundred and twenty-seven thousand dollars of State bonds scaled to \$196,200 of new State bonds.

# 340 FEDERAL AND STATE AID TO HIGHER EDUCATION.

*Agricultural colleges located by the several States under the act of July 2, 1862—Cont'd.*

| Name and location.                                                                 | Amount derived from sale of United States land or scrip. | Number of acres received from the United States. |
|------------------------------------------------------------------------------------|----------------------------------------------------------|--------------------------------------------------|
| Maine State College of Agriculture and the Mechanic Arts, Orono, Me.               | \$116,350                                                | 210,000, scrip.                                  |
| Maryland Agricultural College, College Station, Md.                                | 112,500                                                  | 210,000, scrip.                                  |
| Massachusetts Agricultural College, Amherst, Mass.                                 | 157,538                                                  | } 363,000, scrip.                                |
| Massachusetts Institute of Technology, Boston, Mass.                               | 78,769                                                   |                                                  |
| Michigan State Agricultural College, Lansing, Mich.                                | 278,104                                                  | 210,000, place.                                  |
| University of Minnesota, Minneapolis, Minn.                                        | 178,000                                                  | 120,000, place.                                  |
| Agricultural and Mechanical Department of Alcorn University, Rodney, Miss.         | 113,400                                                  | } 210,000, scrip.                                |
| Agricultural and Mechanical College of the State of Mississippi, Starkville, Miss. | 115,000                                                  |                                                  |
| University of the State of Missouri:                                               |                                                          |                                                  |
| Agricultural and Mechanical College, Columbia, Mo.                                 | 500,000                                                  | } 330,000, place.                                |
| School of Mines and Metallurgy, Rolla, Mo.                                         |                                                          |                                                  |
| University of Nebraska, Lincoln, Nebr.                                             |                                                          | 90,000, place.                                   |
| University of Nevada, Elko, Nev.                                                   | 90,000                                                   | 90,000, place.                                   |
| New Hampshire College of Agricultural and the Mechanic Arts, Hanover, N. H.        | 80,000                                                   | 150,000, scrip.                                  |
| Rutgers Scientific School of Rutgers College, New Brunswick, N. J.                 | 110,000                                                  | 210,000, scrip.                                  |
| Cornell University, Ithaca, N. Y.                                                  | 662,792                                                  | 900,000, scrip.                                  |
| University of North Carolina, Chapel Hill, N. C.                                   | 125,000                                                  | 270,000, scrip.                                  |
| Ohio State University, Columbus, Ohio.                                             | 507,913                                                  | 630,000, scrip.                                  |
| State Agricultural College, Corvallis, Oregon.                                     |                                                          | 90,000, place.                                   |
| Pennsylvania State College, State College, Pa.                                     | 419,146                                                  | 700,000, scrip.                                  |
| Providence University, Providence, R. I.                                           | 50,000                                                   | 120,000, scrip.                                  |
| South Carolina Agricultural College and Mechanical Institute, Orangeburg, S. C.    |                                                          | 150,000, scrip.                                  |
| Tennessee Agricultural College, Knoxville, Tenn.                                   | 371,875                                                  | 200,000, scrip.                                  |
| Agricultural and Mechanical College of Texas, College Station, Tex.                | 209,000                                                  | 100,000, scrip.                                  |
| University of Vermont and State Agricultural College, Burlington, Vt.              | 122,626                                                  | 150,000, scrip.                                  |
| Virginia Agricultural and Mechanical College, Blacksburg, Va.                      | 100,000                                                  | } 300,000, scrip.                                |
| Eastern Normal and Agricultural Institute, Hampton, Va.                            | 95,000                                                   |                                                  |
| Washington Agricultural College, Pullman, W. Va.                                   | 90,000                                                   | 150,000, scrip.                                  |
| University of Wisconsin, Madison, Wis.                                             | 244,875                                                  | 240,000, place.                                  |

1887-88.

† Estimated in millions of United States dollars.

## TABLE A.—EXEMPTION OF SCHOOL PROPERTY FROM TAXATION.

The following facts relative to the taxation of school property have been collected with considerable difficulty and with great care.

The writer has examined the constitutional and statute laws of the several States, as well as many of the State reports, and has written to each State Superintendent of Public Instruction or Secretary or Commissioner of Education, who, in reply, has given the actual practice in his own State. In the majority of cases the State Constitutions grant to the Legislatures power to enact laws for the exemption of

school property from taxation, but in a few instances the Constitutions are imperative, leaving the Legislatures no choice in the matter.

The Legislatures have frequently failed to exercise to the full extent the powers granted them and have not followed constitutional provisions with legislative enactment. In the past, legislation has been highly favorable to non-State schools, and the present general policy, so far as it may be stated, is to exempt from taxation all property used exclusively for school purposes and not held for gain, and to tax all property owned by private or sectarian institutions of learning and held as a productive investment; that is, to tax productive and to exempt unproductive non-State school property.

There are some notable exceptions to this general rule, and the variety of statute laws and their respective interpretation render the practice in respect to the extent of exemption widely diverse in the several States. For instance, Rhode Island and Providence Plantations granted, in the charter of Brown University, "That the college estate, the estates, persons, and families of the president and professors, for the time being, lying and being within the colony, with the persons of the tutors and students during their residence at the college, shall be freed and exempted from all taxes, serving on juries, and menial services. And the persons aforesaid shall be exempted from bearing arms, impresses, and military services, except in case of an invasion." In 1863, it was enacted "That the estates, persons, and families of the president and professors, for the time being, and of their successors in office, shall not hereafter be freed and exempted from taxes for more than the amount of ten thousand dollars for each of such officers, his estate, person, and family included." But the law still exempts all property of every description belonging to the university. The general statute of Rhode Island pertaining to this subject exempts buildings and grounds occupied for educational purposes, the amount of ground so exempted being limited to one acre.

It may be stated, however, that the property of the East Greenwich Academy is not taxed; and that the large property of the Friends School at Providence was free from taxation prior to 1878, but since that time it has been taxed about three thousand dollars yearly.

In Vermont "real and personal estate granted, sequestered, or used for pious, pious, or charitable uses" are exempt from taxation.

The lands set apart for the maintenance of the University of Vermont are leased for the support of the university. They are now and always have been exempt from taxation.

Up to the year 1888 all property of educational institutions in Maine was exempt from taxation, but the Legislature has recently enacted a law which provides that real property, when held as an investment, is taxable in the municipality where it is situated; but the State rebates to the institution whose property is so taxed the amount of the tax, not to exceed one thousand five hundred dollars to any one institution.

A policy similar to that pursued in Maine obtains in Connecticut under the present statute law. The three prominent institutions of learning, Yale and Wesleyan Universities and Trinity College, have productive property exempted, extending in each case to an amount sufficient to yield an income of six thousand dollars per annum.

In the State of Tennessee the law exempts all property of every description managed by a board of trustees and used for school purposes.

This law has been recently tested in the Supreme Court, in which it was found that a tract of land partly occupied for school purposes, but used mostly as a productive investment for the support of the institution, is exempted from taxation.

Kentucky exempts "real estate and investments" devoted to the support of universities, colleges, and seminaries of learning.

The Constitution of Kansas expressly declares that property used for educational purposes shall be exempted from taxation, but the exemption applies to property only in actual use for educational purposes, and hence, as the interpretation shows, unimproved real estate held with a view to future educational use is not freed from taxation.

Illinois reverses the policy and exempts land owned by an institution not in use, but held with a view to future use.

Again, we find that professors' houses are not taxed in New Jersey, and that the same policy prevails in Iowa when the said houses are the property of an acknowledged educational institution.

In Louisiana the law is very explicit in exempting school property and its income from taxation.

Virginia exempts real estate and personal property from taxation, when they or their proceeds are used exclusively for the purposes of education.

Sufficient examples have been given to illustrate the variety and scope of the policies in the different States respecting the exemption of unproductive school property from taxation.

The following table will represent a more complete and exact classification of the provisions of constitutional and statute laws.

*Constitutional provisions for the exemption of educational property from taxation.*

1. Public school houses are exempted in the following six States: California, Colorado, Oregon, Louisiana, and South Carolina.

2. School buildings and apparatus are exempted in the following five States: Arkansas, Georgia, Louisiana, South Carolina, and Texas.

3. Land and grounds used for school purposes are exempted in the following five States: Arkansas, Colorado, Georgia,<sup>2</sup> Louisiana, and South Carolina.

<sup>1</sup> See *State of Virginia v. State Tax Assessor*, 100 Va. 100, 1896.

<sup>2</sup> In some States the Constitution provides, in each case mentioned, that the property referred to "may" be exempted from taxation; in other States the declaration is imperative.

(4) Academies are exempted from taxation in Georgia,<sup>1</sup> Minnesota, and South Carolina.

(5) Colleges, universities, and seminaries of learning are exempted in Georgia,<sup>1</sup> Minnesota, Louisiana, and South Carolina.

(6) Any public property held for educational purposes is exempted in the following thirteen States: Alabama,<sup>1</sup> Florida,<sup>1</sup> Illinois,<sup>1</sup> Indiana,<sup>1</sup> Kansas, Nebraska,<sup>1</sup> Nevada,<sup>1</sup> North Carolina,<sup>1</sup> Oregon,<sup>1</sup> South Carolina,<sup>1</sup> Tennessee,<sup>1</sup> Virginia,<sup>1</sup> and West Virginia.

(7) Property used for scientific purposes is exempted from taxation in the following States: Florida,<sup>1</sup> Indiana,<sup>1</sup> Kansas,<sup>1</sup> Nevada,<sup>1</sup> North Carolina,<sup>1</sup> Oregon,<sup>1</sup> South Carolina, and West Virginia.<sup>1</sup>

(8) Property used for literary purposes is exempted in all of the States named in the last (7th) paragraph.

*Provisions by statute laws for the exemption of educational property from taxation.*

(1) Productive property, or such as is held as an investment for the support of non-State schools, is exempt from taxation in the following States: Connecticut, Indiana, Kentucky, Louisiana, Maine, Minnesota, Mississippi, Nebraska, North Carolina, Oregon, Rhode Island, Tennessee, Vermont, Virginia.

(2) Unproductive property, or such as is invested in buildings, grounds, libraries, apparatus, etc., used and occupied exclusively for educational purposes by non-State schools, is exempt from taxation in the following States: Alabama, Arkansas, Colorado, Dakota, Delaware, Florida, Georgia, Illinois, Iowa, Kansas, Maryland, Massachusetts, Michigan, Missouri, Montana, Nevada, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, South Carolina, Texas, Washington, West Virginia, Wisconsin.

(3) State in which all school property not belonging to State institutions is taxed: California.

<sup>1</sup> In these States the Constitution provides, in each case mentioned, that the property referred to "may" be exempted from taxation; in other States the declaration is imperative.









[Whole Number 105]

BUREAU OF EDUCATION  
CIRCULAR OF INFORMATION NO. 2, 1890

*From Professor Hensdale  
Febr. 7. 1891*

ENGLISH-ESKIMO AND ESKIMO-ENGLISH  
VOCABULARIES

COMPILED BY

ENSIGN ROGER WELLS, JR., U. S. N.

AND

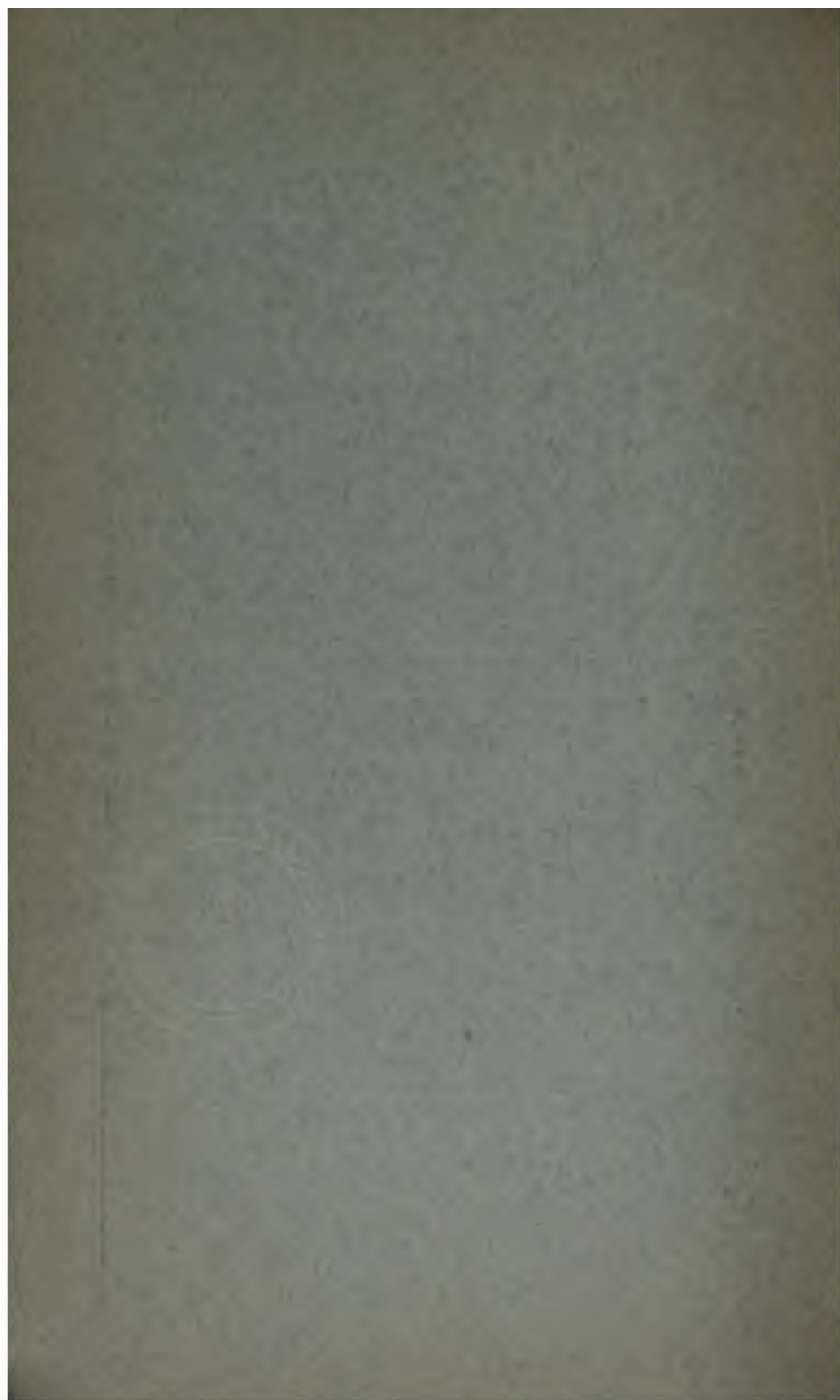
INTERPRETER JOHN W. KELLY

PRECEDED BY ETHNOGRAPHICAL MEMORANDA CONCERNING THE ARCTIC  
ESKIMOS IN ALASKA AND SIBERIA, BY JOHN W. KELLY

WASHINGTON

GOVERNMENT PRINTING OFFICE

1890



[ Whole Number 165 ]

BUREAU OF EDUCATION  
CIRCULAR OF INFORMATION NO. 2, 1890

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36091

ENGLISH-ESKIMO AND ESKIMO-ENGLISH  
VOCABULARIES

COMPILED BY

ENSIGN ROGER WELLS, JR., U. S. N.

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WASHINGTON  
GOVERNMENT PRINTING OFFICE  
1890



## LETTER OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,  
BUREAU OF EDUCATION,  
*Washington, D. C., March 10, 1890.*

SIR: I have the honor to transmit herewith an English-Eskimo vocabulary of 11,318 words, and to recommend the publication of 10,000 copies as a hand-book for the Alaskan teachers.

The introductory note by Lieut. Commander Charles H. Stockton, of the U. S. S. *Thetis*, to whose intelligent foresight the preparation of the work is due, and to whom this Office is indebted for the gift of the manuscript, explains the sources of the material and the circumstances of the compilation.

The Bureau of Education being charged with the supervision of education in Alaska, I have come to appreciate the value of all means or appliances that will in any way promote a better understanding of, and an easier communication with, the native races of that Territory, and I therefore deem the acquisition of this vocabulary as exceedingly fortunate. It will be of great service not only to the teachers for whom it is primarily intended, but to officers of the Navy and of the Revenue Marine service, all Government officials in Alaska, committees of Congress visiting that country, and many others who for various reasons are interested in the study of the Eskimo language. I may add, as evidence for this statement, that the Superintendent of the Census has earnestly requested the publication of the vocabulary as an aid to the Census Office.

The expense of this publication will not be great, and may properly be charged to the fund for the "education of children in Alaska, without distinction of race."

Very respectfully, your obedient servant,

W. T. HARRIS,  
*Commissioner.*

The SECRETARY OF THE INTERIOR.





## INTRODUCTORY NOTE.

The U. S. S. *Thetis* was detailed by the Navy Department to cruise, during the summer and autumn of 1889, in the Behring Sea and Arctic Ocean, for the purpose of looking out for the whaling and commercial interests of the United States in those waters, and also for the purpose of assisting in the establishment of a house of refuge at Point Barrow, the most northerly point of our territory.

During this cruise, in order to make it as broad and useful as possible, several of the officers on board of the *Thetis* were directed to prepare reports upon subjects connected with the waters and regions visited by the ship, from their observation and from other reliable sources. Two reports were submitted to me upon the subject of the Eskimos of north-western Alaska; one on the ethnography of the Eskimos, by John W. Kelly, and the other an Eskimo vocabulary, prepared by Ensign Roger Wells, jr., almost entirely from information and material furnished by Mr. John W. Kelly, the interpreter of the ship. Mr. Kelly spent three winters among the north-western Eskimos, and has been engaged for seven years at various times in acquiring a knowledge of the language. The vocabulary is the largest in number of words that I know of, treating of the language of the Eskimos upon our Arctic coast. It has a short vocabulary of the American Eskimos who are settled upon the Asiatic side of Behring Strait, which, I think, will be found particularly interesting and valuable.

The *Thetis* had the good fortune during this summer of reaching as far east as Mackenzie Bay and as far west as Herald Island and Wrangell Land, thus leaving an honorable name for service among Arctic cruisers. It is to be hoped that the reports, memoranda, and other contributions secured through the ready co-operation of the officers of the ship will serve also to make a permanent and useful record of the cruise creditable to the ship, interesting to the general reader, and of value as contributions to our knowledge of the Territory of Alaska.

CHARLES H. STOCKTON,

*Lieutenant-Commander, United States Navy,*

*Commanding U. S. S. Thetis.*

FEBRUARY 17, 1890.



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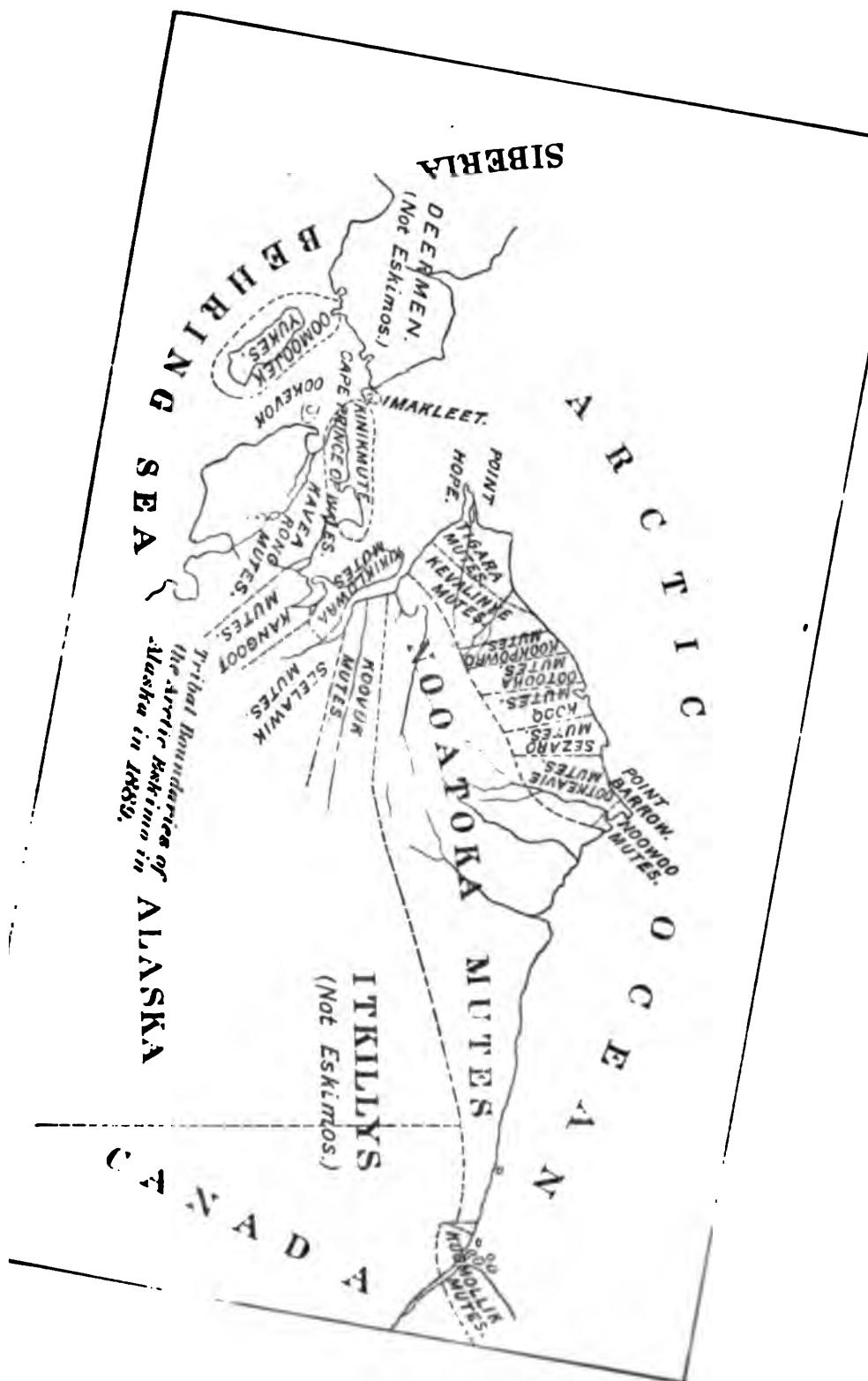
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# MEMORANDA CONCERNING THE ARCTIC ESKIMOS IN ALASKA AND SIBERIA.

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By JOHN W. KELLY.

[ Revised and edited by Sheldon Jackson, D. D., United States General Agent of Education in Alaska. ]

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The Eskimos on the Arctic coast of Alaska claim to be indigenous to the country in which they live; that they inhabited the mountainous region on the north side of Kotzebue Sound before the surface of the Arctic land was changed and before the northern portion rose from the sea. Their traditions assert that in the beginning the people had heads like ravens, with eyes on the upper part of their breasts, and all the world was wrapped in gloom, with no change of day or night. At that time there lived a powerful chieftain on top of the highest peak. Suspended in the roof of his hut were two balls, which were considered very precious, and were carefully guarded. One day, the chief being absent and the guards asleep, some children, who had long admired the beautiful balls, knocked them down with a stick. They rolled across the floor of the hut, through the door, and down the mountain side. The noise awakened the guards, who hurried out after the escaped treasure. The extraordinary beauty of the bounding balls attracted the attention of the people, who rushed after them. A wild struggle for their possession ensued, which ended in breaking them.

Light sprang from one and darkness from the other. These were mighty spirits. Both claimed dominion and neither would yield. At length a compromise was made, and they agreed to an alternate rule. This was the beginning of day and night. Their violent struggles for the mastery had so disturbed the world that the anatomy of the people and the surface of the earth were changed. Light being upon the earth, men began to catch whales in the sea and to carry the flesh and bones to their mountain home.

One family wandering over the country recently arisen from the sea came down upon what is now called Point Hope. Finding vegetation springing up and whales plentiful, they built a hut, and made it their





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One family wandering over the country recently arisen from the sea came down upon what is now called Point Hope. Finding vegetation springing up and whales plentiful, they built a hut, and made it their

permanent home. Years went on and the father and mother died. Some of the children had strayed away and others had returned to the home country, till only a brother and sister were left.

One day they quarreled, and he killed her. Ever after, when out hunting, her spirit would accost him from first one edible plant and then another. At each occurrence of the voice he would destroy the plant with a club. Following her from plant to plant he destroyed them all. She then took refuge in the sun, whose dazzling rays the murderer could not face. He then went to the moon, where with club in hand he could follow her up for all time.

The Eskimos were the only people in the world. Way back in the dim past some of them were carried away on the ice, and managed to live on seals and other animals they killed, until they reached an inhabited land a long distance north of Point Barrow. They remained there until winter, when they returned in safety to the main-land.

#### LOCATION.

Leaving the legendary and coming down to the present, we find the Eskimos occupying the whole Arctic coast of Alaska, together with a portion of the Siberian coast.

#### SIBERIAN ESKIMOS.

There are settlements of Eskimos at Cape Tchaplín (Indian Point), Plover Bay, and East Cape. How long they have been there and how much of the country they have occupied can only be conjectured. Those occupying St. Lawrence Island, Cape Tchaplín, and part of the shores of Plover Bay, on the main-land of Asia, opposite St. Lawrence Island, speak a dialect nearer like that of Point Barrow or the Mackenzie River than the dialects of the Diomedes or Kotzebue Sound. That the Eskimos of Asia have been there a great many years is a certainty. The Deer-men people, whose principal support is domesticated reindeer, have gradually crowded out the Eskimos or Fishmen, and have almost absorbed them by assimilation. They wear no labrets, and in dress and tattooing are the same as the Deer-men. That they have lived in underground houses is abundantly proved by the ruins at Cape Tchaplín of old huts which have been framed with whale jaws of whales. Now they live in huts above ground, covered with walrus hides. They are built in the same manner as those of the Deer-men, who use a covering of reindeer robes. From the Deer-men they have also learned to cremate their dead, instead of scattering the dead bodies over the plain, according to the custom of the American Eskimos. Like the American Eskimos, they deposit the personal property of the deceased at his grave. If he was a great hunter, they also erect a monument of reindeer antlers over his grave. Their songs and dances are to a certain extent the same as those of the Deer-men, but their manner of living and their language

coincide more with that of the people on the north coast of Alaska. At East Cape, Siberia, there is a trace of the Arctic Eskimos, but differing from their nearest Eskimo neighbors, the Diomedé people.

In the vicinity of East Cape there are a few ruins of underground houses, and a few Eskimo words are still used by the people. Twenty miles westward from Cape Tchaplín is Plover Bay, where both the Eskimo and Deermen language is spoken, but the Eskimo is on a rapid decline.

St. Marcos Bay, which lies between Plover Bay and Cape Tchaplín, is inhabited by Deermen; also the country between East Cape and Cape Tchaplín. In fact, the Deermen now have all the country from the Arctic to Cape Navarin and beyond, except the points named. Oomoojek, on Cape Tchaplín, is the Asiatic Eskimo metropolis. The principal industry is whaling, sealing, and walrusing.

The Oomoojek chief, Kohorra, is the wealthiest Eskimo in the north-west. In addition to large stores of guns, whisky, ammunition, and articles of trade, he possesses a large herd of tame reindeer.

#### *ESKIMOS IN ARCTIC ALASKA.*

##### KAVEA TRIBE.

The original home of the Kavea tribe was near the lakes east of Port Clarence. They love to boast of their former greatness. One old fellow, who is a philosopher, geographer, and seer among the Eskimos, made a map of his country of Kavea; although a little out of proportion it is an excellent one in its way. It contains all the mountains, streams, and settlements, with marks to indicate certain minerals. Some of these were afterwards located by personal observation. It includes East Cape and the Diomedes within the bounds of Kavea, which places, he says, were once peopled by the same natives. At the present day, however, the dialect of East Cape is different from both that of the Diomedes and Kavea. The Diomedes and Cape Prince of Wales people have a dialect which is more guttural and harder to understand than any other of the Eskimos.

The Kavea country is almost depopulated, owing to the scarcity of game, which has been killed off or driven away.

The country was once full of Arctic hare and marmots, both of which have been about exterminated. Reindeer have long since been driven away, but fish are still abundant in all the lakes and streams.

The remnants of the Kavea tribe are scattered over whole of Arctic Alaska. Wherever found they are impudent, energetic, and persevering. What few remain at home rival the Kinégans of Cape Prince of Wales in lawlessness. Nearly every year there is a report of from one to three being killed.

## THE TIGARA MUTES.\*

The Tigaras, who inhabit Point Hope and hunt over the hills immediately back of that point, claim that they once exercised control over all the country from Kotzebue Sound north to Icy Cape, and eastward as far as Deviation Peak, on the north side of the Kowak or Putnam River.

Point Hope, being favorably situated for whaling, sealing, and walrusing, with an unfailing supply of food for winter, soon became the centre of power. In the latter part of the eighteenth century, as near as can be determined, the Tigara village on Point Hope had a population of 2,000, with six council houses. At that time the growing tribe of Nooatoks began pressing to the southward and westward, and it was not long before they were masters of the Tigara country westward to the Kevalinye (Corwin Lagoon) between Cape Seppings and Cape Krusenstern. One summer, about the year 1800, a great land and boat fight took place between the Tigaras and the Nooatoks just below Cape Seppings, in which the Tigaras were overthrown and compelled to withdraw from all that part of the country.

They were left in possession of the Kookpuk River, where reindeer pass on occasional years. So badly crushed were the Tigaras that they lost half of their population, which gradually led to the abandonment of all their outstanding villages, the people taking refuge at the capital place of Tigara (Point Hope). The sudden taking off of the leading men, the great whalers and skillful hunters, left the tribe badly demoralized and comparatively helpless.

Before an equilibrium was established half of the remaining population died of famine. Since then the population of the tribe has steadily declined.

They have often attacked parties of whalers who have been on shore after casks of water or driftwood for fuel. Four instances are mentioned: once when the natives were driven off with clubs; another time when they surrounded a boat's crew, pricked the men's throats with knives, stole their tobacco, and cut the buttons from their clothes; again, when they pursued the departing boats, caught hold of their painters, and tried to pull the boats ashore, which was frustrated by cutting the painter. Upon the last occasion, when they attacked a boat in force, the officer in charge stood them off with a whaler's cutting-spade, inflicting many wounds, but it is not known whether any were killed.

In the summer of 1887 a whaling station was established at Point Hope by a San Francisco firm. The natives, under the leadership of Owtonevrok, the Tigara chieftain, kept the station in a constant state of alarm by menaces and threats for more than a year. In June, 1889, the natives made friendly overtures of peace.

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\* *Mutes, that is, people.*

Owtonowrok aspired to be a chief like Kohorra, of the Oomoojeks on Cape Tchaplín, Asia, of whom he had heard. In his efforts to become absolute master of his people he passed from tyranny to assassination. For trivial causes, such as losing something or failing to be prompt in paying tribute, he would sally forth on a shotgun expedition, and either hold the victim while one of his followers did the shooting, or shoot while some one else held the man; but usually he did the holding himself, as he was the most powerful man of his tribe. He became the head chief through defeating the old chief in a rough-and-tumble fight.

February 14, 1889, he was shot dead by two brothers, whom he had exiled, and who had returned for the purpose of killing him. During his life he killed five men and one woman. He inspired such terror that every year people left for distant hunting-grounds, till it seemed that a few more years of his reign would have seen Tigara depopulated.

Women take an active part in battle or assassinations by holding on to an enemy or otherwise impeding his movements. In executing an offensive movement the women have been noticed to get in the rear of an enemy to obstruct his retreat.

The Tigaras exchange arms and ammunition, obtained from whale-ships, with the Nooatoks and Kevalinyes for furs. Whale oil and seal-skins are bartered for deer-skins and children. A child costs originally about one seal-skin bag of oil, or a suit of old clothes. If not resold they are brought up in the family purchasing them to do menial work as soon as able. As they grow up they are made to believe that their parents were bad people and that they would have died if they had not been taken in by their present owners. When grown they are free. Not knowing any other dialect or having any other home, they stay where they are and become recognized Tigaras. Owtonowrok, the chief, had a Nooatok boy, whose fidelity he afterwards rewarded by creating him chief, next in power to himself.

#### KINEGAN MUTES.

The nineteenth century has witnessed the rise and fall of the Kinegans of Cape Prince of Wales. A band of hypocrites and shysters, possessing a large share of brazen effrontery, led on by what they believed to be invincible unutkoots (seers), they overran the country to the southward and eastward as far as the Selawik River. Taking the highlands for bearings, they sailed boldly across Kotzebue Sound from Cape Spanberg to Hotham Inlet and Cape Krusenstern, where they founded colonies, hunted reindeer, and plundered and scattered the habitations of other tribes.

They have a traditional story of having defeated and driven the Russians out of Kotzebue Sound. It is probable that they have reference to Beechy's English expedition, as there is a record that a surveying party

of that expedition was attacked and lost in an encounter with the natives in 1827.

In 1868 a whale-boat's crew from a wrecked vessel was making its way southward to civilized settlements, when it fell in with a band of Cape Prince of Wales natives on the north side of Kotzebue Sound. Some of the natives held knives to the men's throats, while others robbed and stripped them of everything they had, even to their clothing. After suffering many hardships the whalers reached Point Hope, where they were finally rescued.

Every December moon 150 or 200 Cape Prince of Wales natives would go over to Kavea, before they impoverished it, on a tax-collecting expedition. Upon their arrival the whole population would be drawn up in line just outside the village, when the old men would beat drums, while two elegantly dressed women, springing into the open place between the two tribes, danced in their most graceful style. While the women were dancing two young men would dash into the arena armed with bows and arrows, dance stiff legged, draw their bows, aim east, west, north, and south. The whole ceremony being one of submission and a declaration that they stood ready to defend themselves and visitors from enemies from all directions. The performance being over, huts and council houses were thrown open, and dancing, games, and theatricals were indulged in till the food became scarce, when the visitors departed.

Beginning about the year 1860, vessels have been fitted out at Honolulu and San Francisco for the purpose of trading in Arctic waters. These are careful not to be surprised or captured by the natives of Cape Prince of Wales.

Soon after the acquisition of Alaska by the United States (1867) these people captured and plundered a San Francisco trading vessel. Encouraged by this success, and having as their leader an unutkoot, whom the natives considered invulnerable, they seized and boarded a Hawaiian brig, commanded by George Gilly, a Bouin Islander. The natives drove the crew below, killing one man. The chief caught Gilly by the throat and began pressing him back, when Gilly drew a revolver, but was only jeered at by the chief; striking the chief over the head with it and loosening his hold he shot him dead. In the meantime the mate had come on deck with a rifle, but was seized by the second chief, and in the struggle for the gun both fell to the deck. Watching his opportunity the nobleman brained the native with a spare tiller. Gilly and the mate then took up positions at the ports in the forward part of the poop and opened fire on the natives, who swarmed on deck. Becoming panic-stricken, they fled into the rigging, and many sprang over the sides of the vessel, capsizing their canoes, and were drowned. Those that were left sought refuge under the top gallant fore-castle. When drawn out of their hiding places with long boat hooks, they ran with drawn knives upon the crew and fought until knocked dead with cap-

stan bars. Fifteen natives lay dead on deck. The number drowned is not known. This incident broke the power of the Kinegans.

The unutkoots, who claimed to be invulnerable, were found to be but ordinary men. The conquered tribes, denouncing them as "liars," "frauds," and "ashooruk oklah" (very bad), asserted their independence. Shotgun parties for the purpose of collecting tribute became obsolete.

The Kinegan colonists north of Kotzebue Sound and elsewhere, finding their locations too dangerous, returned to their own region. The Kinegans still hold the little Diomede, and the coast-line between Cape Prince of Wales and Cape Spanberg, but the population has steadily declined, and within the last three years families have begun to migrate northward, and now they are to be found scattered along the coast as far north as Point Belcher.

#### COLONIES OF OUTLAWS.

On the south side of the headland just below St. Lawrence Bay, on the Siberian coast, is a colony of murderers gathered from different settlements on the Asiatic shores of the Behring Sea, where they dwell unmolested by surrounding tribes.

In Eskimo Alaska there is not only a settlement, but a considerable tribe of Arctic Ishmaelites who are called Kevalinyes, whose home lies between the Tigaras and the Nooatoks. They claim allegiance to the Nooatoks and ought to be classed under that head, but are spoken of here under a separate heading on account of their peculiarities. The larger number of these people are of Nooatok origin, re-enforced by desperadoes from Cape Prince of Wales, Kavea, and Point Hope.

They have been continually encroaching on the hunting-grounds of the Tigaras, who have repeatedly sent them word to pack up and move or be cleaned out. To these threats no attention has been paid.

Within the last three years they have even extended their ground to the shores of the Arctic, appropriating the northern portion of the Tigara hunting-ground, which lies south of the Kookpovoros at Point Lay. The Eskimos are given to boasting of their intentions. In most instances offensive movements are thus anticipated. Whenever the Tigaras have started out on a shot-gun adjustment expedition, the Kevalinyes have had time to call in a sufficient number of their people to prevent an attack. During the winter of 1889, the Kevalinyes advanced to the westward of Cape Seppings and killed a prominent Tigara native. As soon as the news reached Point Hope an armed party started out to avenge the murder, but did not dare advance beyond Cape Thompson. At no place are hostilities continuous. There are always seasons of civility, when they visit each other for the purpose of trade.

#### TRIBES DYING OUT.

The other coast tribes between Point Hope and Point Barrow have been cut down in population, so as to be almost obliterated. The Kook-



povorots of Point Lay have only three huts left; Ootookas of Icy Cape one hut; Koognute has three settlements of from one to four families; Sezaro has about eighty people.

#### POINT BARROW.

Ootkeavie, at Cape Smyth, 8 miles from Point Barrow, has a population of about 360, and is the largest permanent settlement in Eskimo Alaska. Its people are drawn from all portions of the territory north of Behring Strait, being attracted there by the favorable situation of the place for catching whales and killing deer.

Noowoo (Nuwuk), on the extreme end of Point Barrow, has a population of less than 100. Its people are native to the soil, and are undoubtedly the only true relics of the old stock of Eskimos within the bounds of Alaska.

#### THE NOOATOKS.

The Nooatoks, originally called Napakato Mutes (timber people), began their tribal existence in the timbered country at the headwaters of the Nooatok River. Like the herds of Genghis Khan they have moved east and west, occupying as much of the territory as suits their purpose.

The golden age of the Eskimos, as a whole, was probably two hundred or more years ago, before they felt the pressure of southern savages. Of individual tribes the Tigaras were at the height of their power about 1775, the Kayeas about 1800, Kinegans 1860, Ootkeavies about 1870.

The Nooatoks just now are in the ascendant and promise to overrun the whole country. Around Point Barrow they have obtained a footing; at Point Hope they are gradually accomplishing the same end by selling children to the Tigaras.

They are also gradually working in their dialect among the old Eskimo stock.

The principal dialects of Arctic Alaska are:

##### Old Eskimo:

1. *Ootkeavie*, Cape Smyth and St. Lawrence Island.
2. *Koognute*, straits between Icy Cape and Point Barrow.
3. *Kayear*, Mackenzie River.

##### Mixed Eskimo:

1. *Kinegan*, Lake region back of Fort Clarence.
2. *Kayear*, Cape Prince of Wales and Thomsen.
3. *Arctic*, Kotzebue Sound and land to Arctic Ocean.

A few words will serve to show the variations of the language in different localities.

- |    |                                                               |
|----|---------------------------------------------------------------|
| S. | St. Lawrence, St. Lawrence Islands and north coast of Alaska. |
| M. | Merrus, Thomsen and Kayear.                                   |
| M. | Mackenzie, St. Lawrence Sound.                                |
| A. | Arctic, Thomsen.                                              |
| A. | Arctic, Nooatoks.                                             |
| A. | Arctic, Mackenzie River.                                      |

The language is difficult to understand on account of there being so many synonymous terms. As many as six different names have been found for the same thing in a single tribe. What may be the traditional name of an object in one locality may be the common appellation in another.

#### PERSONAL APPEARANCE.

There are three types observable among the Arctic Eskimos of Alaska. The tall, cadaverous natives of Kangoot, Seelawik, Koovuk, and Kik-iktowruk, on Kotzebue Sound, who live on fish, ptarmigans, and marmots. They always have a hungry look, and habitually wear a grin of fiendish glee at having circumvented an adverse fate. There is a tendency among these people to migrate north.

Then there is the tall, strongly knit type of the Nooatoks, a gigantic race, of a splendid physique that would be remarkable in any part of the world.

Rugged as the mountains among which they live, vigorous and courageous, they stop at nothing but the impossible to accomplish a desired end. Their food supply is the reindeer, mountain sheep, ptarmigans, and fish. There are many of the coast natives of this type, but they lack the healthy glow and the indomitable will of the Nooatoks.

The third type is the short, stumpy one, probably that of the old Eskimo before the admixture with southern tribes, now found on the Arctic coast. Whale, seal, and deer meat are their food staples.

The Eskimos have coarse, black hair, some with a tinge of brown. Many of the coast people of both sexes are bald from scrofulous eruptions. Males have the crown of the head closely cropped, so that reindeer may not see the waving locks when the hunter creeps behind bunch grass. They have black eyes and high cheek bones. The bones of the face are better protected from the severity of the climate by a thicker covering of flesh than southern races.

Among the coast people the nose is broad and flat, with very little or no ridge between the eyes. The adult males have short mustaches, and some of the elder ones (more noticeable in the interior) have rough, scraggy beards. Generally their beard is very scant, and most of them devote otherwise idle hours to pulling out the hairs. All have good teeth, but they are subjected to severe usage, being used for pinchers, vises, and fluting-machines. The teeth are employed in drawing bolts, untying knots, holding the mouth piece of a drill, shaping boot-soles, stretching and tanning skins. When they become uneven from hard usage they are leveled off with a file or whetstone. A woman at the age of forty who has done her share of the house-work generally has her front teeth worn down so low that they are useless for mechanical purposes.

#### ORNAMENTATION.

At any time from sixteen to twenty-two years of age the male natives have their lower lips pierced under each corner of the mouth for labrets.

When the incision is first made, sharp-pointed pieces of ivory are put in. After the wound heals the hole is gradually stretched to half an inch in diameter. Some of the poorer natives wear labrets made from cannel coal, ivory, common gravel, and glass stoppers obtained from ships, which they shape for the purpose. All who can obtain them have agate ones. One labret is nearly always plain, and shaped like a plug hat, with the rim inside the mouth to hold it in; the other has a white washer an inch and a half in diameter just outside the lip, held in place by a nut of turquoise fastened to the end of the labret by petroleum pitch from Ivy Reef or spruce gum from the Nooatok. It is not known where they have obtained the turquoise or the porcelain-like washer. The natives say they have always been in the country, and have been handed down by successive generations. Some of the old men who have made a good record as whalers tattoo their cheeks; some of the designs are triangular, an inch long, with one point intersecting the corner of the mouth. Another kind is a rectangular bar an inch and a half long, extending from the corners of the mouth toward the ears.

Some of the girls have their ears pierced just back of the lobe, where it is thinnest. They wear ivory ear-rings, some of which are carved with plain figures, while others have a setting of turquoise. Some of them have a string of beads extending from one ear-ring to the other, suspended under the throat. There are rare instances where the Cape Prince of Wales girls wear turquoise beads suspended to the cartilage of the nose between the nostrils. Tattooing the chin among the women is general, and it is kept up, so they say, because it has always been the custom. At the age of six one narrow perpendicular line is drawn down the centre of the chin, powdered charcoal being used in coloring. At about twelve years of age the line is broadened to a half of an inch, and a narrow line drawn parallel to it on each side. Sometimes the tattooing is delayed till the child has grown up and has the work done to suit herself, either with the narrow line, the broad line, or three lines. Some of the Kangoot women on the south side of Kotzebue Sound have been pierced with two narrow lines on each side of the broad one, and there are rare instances where the tattooing has been delayed till the birth of the first child or even longer. The women all have remembrance notches tattooed on their wrists or back of the hands. The women wear their hair in braids, except when it is tied in two loose locks just below the ears. Mackenzie River women wear the hair in two rolls forward of the ears, hanging down, and a small pig-tail behind.

#### DRESS.

Clothing for men consists of knee breeches, belted at the loins, a loose-fitting coat, trimmed around the bottom, and the hood with wolf or wolf-skin, or a bending of both, a pair of stockings and a short legged pair of boots with seal skin soles. In winter two suits are worn, the *inner suit* with the hair next to the body and the other with the hair

turned out. In summer water-proof tanned seal-skin boots are substituted for reindeer ones. Gloves are made of reindeer-skin with the hair turned in. Each tribe has some peculiarity of dress. Those south of Port Clarence (Cape Douglas) and those north of Point Hope wear shoulder-straps of different-colored furs trimmed with wolverine. Point Hope natives put little white tanned seal-skin tassels around the top of their summer boots, and others do not. The old Eskimos at Point Hope and Point Barrow fashion their boot-soles high, and cut out the upper in one piece, and sew their water-proof boots and mittens without a welt, while the Kavea and Diomedes make the sides of their boot-soles low, have the upper in two pieces, and sew with a welt. Old people often have portions of their clothes made of duck-skins, which are said to be tough and warm. All of them like to have civilized clothing for summer or indoor wear, which can be washed, so as to keep down vermin. The difference between the dress of men and women is that the latter have their boots, stockings, and pantaloons all in one garment. The cloaks of all females have at the back of the neck a fullness, for carrying infants. These cloaks come down below the knees and are gored out at the sides up to the hips, making the front look like an apron.

The chief employment of the women in winter is dressing skins and making clothes.

When the snow begins to melt in the spring, they cease manufacturing, and only repair or fit a garment when absolutely necessary.

#### CHARACTER.

They are intelligent beyond what might be expected of them, and have good natural abilities. They are quick in providing ways and means in cases of emergency. They are also anxious to adopt the methods of white people when they can do so to advantage to themselves. Some of them carve with a knife on pipe-stems, or drill bows made of mastodon or walrus ivory, pictures illustrating events in the life of the artist, tribal history, or festal occasions. There are instances where they have communicated with each other by means of pictures carved on wood or ivory. In their drawings they have no idea of the perspective, and instead of drawing from nature they are more apt to incline to the grotesque and hideous, just as the fancy may seize them. Our pictures are unintelligible to them, unless they are distinctly ludicrous.

They know no other motive than that of selfishness. Anything they part with is with the expectation of a double remuneration in the near future. Any promise of reward next year they deem idle talk and are unwilling to understand it. Everything is right if it coincides with their wishes, and everything wrong if it is contrary. Any man may have their friendship if he can pay for it; otherwise he must take the consequences, good or bad. The Eskimos have been proverbially honest and truthful in their dealings. Aside from forcible appropriations they

rarely steal anything, unless it is some small trinket of very little value. Any little article stolen may be easily traced, as it is not in their nature to conceal a theft or keep a secret. Up to this time there has been no white man among them who can equal them in hunting, fishing, sealing, and shore-whaling. Judging from their stand-point they say the white man is "ilualok" (unfit for anything), nor have they any respect or veneration for anything pertaining to the whites.

#### CUSTOMS.

The Eskimos on going to bed strip off all their clothing and huddle together under reindeer-robes. The males scarcely ever wash their face and hands, and their bodies never. All births and deaths take place in out-houses.

Women carry their young astride their backs. The child is held in place by a strap passing under its thighs and around over the mother's breasts.

Children are given from two to six names, but none of them are those borne by the father or mother, but are those of ancestors or respected relatives. The literal meaning of the names are stone, foxes of different kinds, seals of all varieties and sizes, birds, animals, parts of animals, of birds, of fishes, or of the body, sections of the country, winds, tides, motion, fast or slow, decorative articles, and names compounded in an expressive way, as Amok Tigara, the she wolf of the Tigarus.

Idiots and partially demented persons are permitted to live, contrary to what might be expected of these people; but the unfortunate wretches are only fed on refuse food, and if clothed at all are only given old worn out garments. Fortunately only an occasional idiot is to be found.

#### COURTSHIP AND MARRIAGE.

Girls after they have reached puberty, at about thirteen years of age, have no one to protect them. Neither father, mother, or brother will raise a hand toward of a ruffian who would outrage them. Eskimo girls are naturally modest, shy, and of a retiring disposition, and it is a severe shock to them to be pounced upon as a hawk would grab a dove. They often fight furiously until their clothes are cut or torn from them and they are beaten insensible. After a while they will not resist so heroically. Though tears fall like rain, the male Eskimo, youth or middle-aged, never relents. When a girl has finally taken a husband she is no longer modest. An Eskimo begins his courtship by making the girl presents of food delicacies, such as deer breast, tongues, and seal's liver. Then he has as the cloak made as his resources will permit, which is intended for the girl. Should she accept and put it on, he has won her, but she often hesitates, sometimes rejecting all advances or putting off some other day. Should the latter be the case the man begins again to go. She is waylaid and harassed upon every occasion. The

persecution is kept up for days and months before the man gives up, leaving the field for the next comer. When a couple does mate, the relation is scarcely ever permanent. Before they become settled they may have had a dozen or more matrimonial ventures. Women are inclined to be true to their husbands, and probably would be if the men did not insist on exchanging wives for a season, or prostituting them for a revenue to whalers.

Women are kept in the huts a month after confinement, and are not allowed to enter any other house than their own till the season, summer or winter, is over. Maternal cares and drudgery make their lives such a burden that they often destroy their unborn offspring. Some of them do this secretly, and if it is found out by their husbands they are beaten till insensible, then thrown out of the house. Women who have been badly treated have hanged themselves. This last winter (1889) a Point Hope man, jealous of his wife, whom he had taken from the Nooatoks the summer before, hammered and cut her up with a knife. Despairing of life or liberty, in the night, during a raging blizzard, she fixed a noose around her neck, hitched some dogs to the hauling-cart, started them up, and was dragged to death.

Here are some of their love songs, in which I have preserved the meaning:

OKANITOO (LITTLE WOMAN).

Oh! Okanitoo! This I'll do  
To win your noble heart;  
In command of a magic wand  
I'll cleave the mountains apart.

There, below the surface of snow,\*  
By the eternal hunting-ground,  
A hut I'll build of rarest guild,  
Where love may ever abound.

On wings I'll rise to the leaden skies  
And drag the Aurora down,  
Its trembling bars with glistening stars,  
To make thee a wedding gown.

The rainbow, too, of varied hue,  
For a bonny belt I'll bring,  
The new moon trap, the ends I'll lap,  
And weld thee a finger ring.

I'll hunt the hare, I'll fight the bear,  
And banish the wolves for good;  
Whales and deer, and seals I'll spear,  
We'll never want for food.

When this is done, I'll moor the sun,  
And turn the blizzard away;  
The winter's blast forever past,  
We'll live in endless day.

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\* The Eskimos' happy hunting-ground is below the ground, out of the cold.

## KAVANA.

My little Kavana, my pretty Kavana,  
Higher mounts the sun in its aerial ride,  
And winter's darkness will soon be gone,  
Will you be now my own bonny bride?  
Not for a day, but forever and a day?  
I know very well I have loved a host  
(And who has not, I'd like to know)  
Of beautiful girls up and down the coast.

My dearest one, my beloved one,  
Very soon the snow birds will be here,  
Perhaps with the next southerly gale,  
To usher in our Arctic New Year.  
Accept me do, for I love you true;  
You "have hunted and mated with dozens before,  
And plighted" you say "to another man;"  
Then we are even, why hesitate more?

My darling girl, my own dear girl,  
We'll soon leave our underground home,  
To pitch our tent on some inland creek,  
Once more my dear, will you, will you come?  
What! mine at last, suspense is past,  
Mine you are for woe or for weal,  
Now, my wife, I'm hungry as a gull,  
Off with your cloak, and skin that seal.

## AHKETUCKY.

Ahketucky, tucky tah,  
Ahketucky, tucky tah,  
Omnyah has a handsome face,  
Lovely form, and winsome grace;  
An arrant flirt, a coquette,  
Easy to court, but hard to get.  
Ahketucky, tucky tah,  
Ahketucky, tucky tah,

Allungow is a slave to work,  
Toil all day and never shirk;  
But any girl that I wed  
Works, or I break her head.  
Ahketucky, etc.

Reshona, by angels given  
From the fairest band in heaven,  
Beautiful nymph, blessed ever,  
Adore always marry never.  
Ahketucky, etc.

Okpukto, of noble mind,  
Honest, upright, and kind,  
Exalted, incomparable virtues;  
But goodness brings no revenues.  
Ahketucky, etc.

Anakeho is a little ghoul,  
 For plunder yields her very soul,  
 And she shall be the wife  
 To share my lot in life.  
 Ahketucky, tucky tah,  
 Ahketucky, tucky tah.

## POLYGAMY.

Polygamy is hereditary. If a father has a plurality of wives the sons also have an equal number, without regard to wealth or ability to support them. Many natives have two wives; there are rare instances of a man having three wives, and Owtonowrok of Tigara had five wives at the time of his death. He had previously killed one, and scarcely a day passed that he did not club or carve one or more of them. At his death the first wife took possession of all the property, to be held in trust for her eldest boy, twelve years of age, to the exclusion of all the other children or relations.

## DISEASES.

The natural bodily ailments of the Eskimos are scrofula, diphtheria, bronchial, and pulmonary diseases. Many men are affected with sore eyes and partial blindness, brought on by the excessive refraction of the sun's rays on the white surface of snow during the months of April, May, and June. Left to themselves the Eskimos would have continued to battle successfully against these disorders; but the white people introduced syphilis among them. This has been a blight that has almost swept some of the coast tribes out of existence, and bids fair to depopulate the whole Eskimo country. The Nooatoks, being an inland tribe, have been comparatively free from it until lately, but the blight has now begun to affect them also. They might have had immunity much longer had they not forced their way to the sea-coast, where they could have communication with the whale-ships. They now come in boats to Point Hope, cross the mountains to Point Lay and vicinity, and go in large numbers every summer to Point Barrow.

According to an Eskimo's idea there is no wrong in adultery, especially among themselves, and it is correct with whalers if there is a consideration; consequently, it does not take much time to scatter the germs of disease among a whole people.

The Diomedé natives are not given to promiscuous intercourse with whalers. The Oomoojeks, of Cape Tchaplín, Siberia, called a halt some years ago before it was too late.

The Kinégans, of Cape Prince of Wales, and the Kotzebue Sound tribes are not badly corrupted yet; but on the north coast there is the grossest abandon. The moral status of the Eskimos is very low, not above that of the brutes. The only thing they have been known to deery has been that of mating with blood relations. There are instances, however, of



brother and sister, parent and child, while that of uncle and niece is quite common.

All their songs, stories, and traditions are of a ribald nature. In fact, obscenity is flagrant everywhere. The knowledge they have gleaned from white people has been from a commercial stand-point. Moral ideas have not yet reached them. Satisfaction of personal desires without regard to consequences has hardened them in their ways of iniquity.

People when stricken with what is thought to be a fatal illness are carried out to the out-house, where, if they do not die according to their expectations, they request some one to kill them, and their wish is complied with by an unutkoot (seer), who stabs them with a knife either in the breast or temple; the knife is then buried by the unutkoot. Pieces of graphite or other black stones are placed on the eyes of the deceased, the body is wrapped up in reindeer-skins, and carried out for immediate burial, the head always being placed to the eastward. The body later on is usually placed in a crude box, and is generally left on the ground, though it is sometimes placed on stilts or a frame. Four days after a death the family remain in mournful idleness, and are not allowed to enter another house until the expiration of one moon. Just after a burial the natives walk around the body, then form a ring and drop stones down through their cloaks, after which they file away homewards. Just before the whaling season the Point Hope women are made to carry a piece of whale blubber out to the cemetery and place it on the grave of a deceased whaling relative. That the woman may not neglect the duty through tamidity, a man goes along after her carrying a club. Men not having a wife, sister, or mother, or other woman dependent upon them carry the meat themselves. The bodies of people who die during the whaling season are cut open, and any pieces of whale blubber found in the stomach are thrown into the sea.

#### SHAMANS.

Unutkoots are the seers or medicine men, and are divided into seven degrees. The vocation is hereditary, as far as a son or a daughter may mentally or physically be able to acquire the knowledge. They are graded according to their knowledge of spiritualism, ventriloquism, feats of legerdemain, and general chicanery.

An unutkoot of the seventh degree claims to be immortal; that his vision and knowledge extend beyond that of the world, to that of the spirit life; that he can not be killed or even wounded. Those of this grade are often heard of but never met with. Sixth grade unutkoots may be wounded but not killed. Those of lesser grades are less pretentious; they go into trances, during which the spirit leaves the body, roams about the other world, communicating or treating with other spirits.

Sickness is supposed to be manifestations of evil spirits or devils, which have taken possession of or located themselves in the body.

An unutkoot of the higher grades in treating a patient darkens the

room or waits until night; then in the presence of the assembled house, hold he begins operations; he takes his drum, made of walrus bladder stretched over a hoop, strikes it against a stick, making a doleful sound, during which time he alternately commands and exhorts, exciting loud and fervent ejaculations from the assembled people. At first the performance is mournful, but the unutkoot soon warms up and the performance becomes livelier. He winds up each peroration with a questionable glance at the audience, as if to elicit approval; then the responses become more in keeping with a hilarious entertainment, such as "good boy," "go it Tommy," etc.

In the next act he removes the patient's clothing, breathes upon and sucks the parts affected; then bringing his powers of ventriloquism into play, he pretends to carry on a conversation with invisible spirits. Again the drumming and incantations are gone through with. Suddenly all noise ceases; then he flips his right hand behind him, throwing little pebbles on the floor or ground, so as to imitate the sound of an animal scurrying away. The patient is then told that the devil is gone. If it is only a slight illness or mental depression, their faith is so great that the afflicted one gets well anyhow.

In treating rheumatism, swellings from fractures, or syphilis, in addition to the incantations they fearlessly use a knife in lancing, always cutting into the part affected, where they insert a goose-quill to let out blood or pus. They cut deep, without regarding the state of the wound or whether it is ready to be lanced or not. Using no anæsthetic and carving deliberately with a knife that is not remarkable for its sharpness, the patient endures the most intense agony, his screams being heard all over a village.

In dealing with children an unutkoot wears a mask and howls in a disguised voice to scare or divert their minds. The performance being over he takes his drum, goes around a house, chanting and beating an accompaniment, and describing a magic circle, to keep prowling devils away.

There are women unutkoots, but none of a high degree.

Eskimos who are not unutkoots use a stick 4 or 5 feet long, one end of which is held against the instep of a patient, while they chant in anxious efforts to banish or appease the tormenting devil.

Some of the tricks of legerdemain by which the unutkoots mystify their people are apparently driving a knife into their bowels without making a mark; taking a marked bead in their hand, showing it to the audience, toss it carelessly out into the snow, and later on remove what appears to be the same bead from some man's ear; they take a piece of twine, cut it into two pieces 2 inches long, open the mouth to show that it is empty, put in the bits of twine, a piece at a time, chew them up, then, after much heaving of the chest, draw forth from the throat the twine in its original length.

## RELIGIOUS BELIEFS AND SUPERSTITIONS.

Eskimos are believers in ghosts. They also believe in the transmigration of souls, that spirits return in animals, winds, rocks, ice, and water, that they are evil, angry, or good, as the elements may be favorable or unfavorable, and that they can be appeased by hoodoo rites if the performer is sufficiently versed in occult sciences. Childless women, it is claimed, can not return to the surface of the earth after death. To change the wind, for instance, they chant, drum, and howl against it, build fires, shoot against it, and as a last resource fire the graves of the dead. Tribes put hoodoos on each other by ceremonial dances and howling. The hoodoo of total destruction upon neighbors is the building of a fire within sight of those coming under their displeasure. Tribal relations are severed by making a fire outside and burning all ornaments or disguises used in ceremonial dances, such as raven skins, eagle tails, deer horns, and masks. Tribes that are hoodooed answer by a return hoodoo, but with families and individuals it is different. Outlawed by their tribe or relations, they become discouraged, hopeless, and gloomy, and literally "go off and die." In whaling, a husband is hoodooed if his wife is confined within three months of the whaling season, or a death hoodooes the whole family till the boat in which they intended to work gets a whale; then if the same boat gets another whale the women folks are released from the hoodoo and may go out on the ice.

Seals when brought home are offered a drink of water; a little of it is then poured on the seal's nose, and the rest thrown into or toward the sea. The same custom is observed toward the white grampus (beluga demer) and whales when killed and brought alongside the ground ice. Eclipses of the moon create the greatest consternation and almost paralyze the people with fear. Arctic earthquakes having been coincident with eclipses of the moon, they say that an eclipse is the shadow of the earth being piled up and shaken. All the umtkoots in a village will howl and drum till it is passed, claiming that they have driven the thing away. Among the Nootoks all hands rally around a pair of buckhorns, form a circle, and march around to the music of drums and wild chants till the eclipse is off. One old Eskimo described a calm as being a struggle between spirits of the wind from opposite directions.

## FESTIVITIES.

Festal occasions are early in December, when they have a kind of harvest home, entertainments being given every day by each hut in succession, with an evening dance in the assembly house. A day will be devoted to whales, another to reindeer, others to seal, their whale-boats, sleds, husbands, sweethearts, and wives. This festival is kept up until the whole program is completed or some one dies through exhaustion in dances of endurance.

The next is that of good-cheer, in June, when they quit whaling and exchange presents, give scraps to the poor, and toss each other up in blankets. Another season of gaiety is when the representatives of different tribes meet at the summer rendezvous for the purpose of exchanging commodities. Dancing, foot-races, and wrestling matches are indulged in. Both sexes join in games of polo, foot-ball, and tag. In summer girls toss sandstone balls with their hands, two balls with one hand, or three balls with both hands. In winter they toss an ice-ball with their feet, keeping it from touching the ground for hours at a time; sometimes they toss it from one to another. Sometimes the exercise makes their feet so sore that they tie a reindeer-skin pad across the top of the foot.

In December, 1888, a little Kevalinye girl, when every arrangement had been made for her taking a husband, begged one day more of freedom. Taking her ice-ball she tossed it throughout the short gloomy day till it was too dark to see, mummified of the cutting wind and drifting snow.

#### HUNTING.

The primitive methods of taking game were:

(1) *Reindeer*, with bows and arrows; rawhide snares secured among the dwarf willows that line the creeks; great brushwood corrals in the timbered country, where herds were driven to be slaughtered; chasing them with kyaks and spearing them to death while crossing lakes or lagoons; latterly, chasing herds of deer with dogs, after the fawns are dropped into the rivers and rushing torrents, where the fawns are drowned.

(2) *Seal*.—With nets suspended under blow-holes, or spearing them when they put their heads into the blow-holes.

(3) *Walrus*.—They are speared first and then lanced.

(4) *Whales*.—Striking them with spears to which 20 fathoms of walrus line is attached, with three seal-skin pokes or air-bags tied to it. These pokes keep the whale from sinking while the natives get around it with their boats, lance and worry it to death.

(5) *Birds*.—Ptarmigans are caught with little nooses set among dwarf willows and with nets staked down into the snow, into which they are driven. Lapland larkspur are caught with tiny nooses made of whale-bone thread. Little auks, puffins, and crow-bills are caught with nets suspended over cliffs. Ducks, geese, and brants are brought to the ground by means of ivory or bone balls tied together with sinew thread, thrown into flocks, where they wind around the necks of the birds.

(6) *Foxes* are caught with dead fells or automatic nooses set in holes in the snow. The fox in pulling at the bait draws the halter around his own neck, until, alarmed, he surges back and is strangled.

(7) *Lynx* they run down till close enough to shoot.

The primitive ways of taking reindeer have been abandoned, except under favorable circumstances among the Nootoks. Since the intro-

duction of fire-arms the reindeer are too scary to be approached with bows and arrows.

The natives depend on reindeer for all their clothing and bedding, and particularly for tents and houses. The Alaskan Eskimos north of Behring Strait kill about fifteen thousand annually. Many of the natives have adopted American methods of taking whales, in a modified way. From Cape Prince of Wales to Point Barrow they get about thirty whales annually of all sizes. The whalers have almost eliminated the walrus from their food supply. Of seals they get about twenty thousand annually. Like the deer, they are killed with repeating-rifles, of which the natives have the latest and best patterns—Winchester 15-70, 15-60, and 14-50. Hotchkiss's, Marlin's, and Kennedy's express and telescope rifles are also met with. There is scarcely a male Eskimo over twelve years of age who does not own one or more repeating-rifles. They receive annually from the ships \$30,000 worth of arms, ammunition, muslin, and flour, at San Francisco prices, in exchange for their furs and whalebones. As there is much rivalry between different traders, the natives receive full valuation for their products.

#### DRESSING SKINS.

When the snow has whitened the ground, and the streams are frozen over, the women begin dressing skins.

First they dry and scrape the skin, removing the fat; then it is moistened and put under pressure several hours, when it is taken out and wet with warm water as it is scraped. This done, it is thrown over a line to dry; then as it is scraped it is sprinkled with chalk or any kind of white rock pulverized, which when done leaves the skin soft and white. The best working women can dress two reindeer-skins for ordinary purposes within twelve hours, but a fine job requires three days for one skin. Sometimes the skins before being made up are dyed a dark brown with a decoction of alder bark, obtainable south of the Chapomeckarook Mountains.

#### DWELLINGS.

The coast natives have fixed villages of underground houses where they live in winter. In summer they scatter out in different parts of their hunting grounds or go to the different places where the natives meet to exchange articles of trade. During these excursions they live in muslin or deer skin tents.

The Nootoks have no fixed abode of underground houses, but live in huts framed with spruce poles covered with reindeer skins. In winter the huts are deeply covered with snow. In the latter part of May, when the snow begins to thaw, they take out their effects and pitch a tent on the surface of the snow. As soon as there is a bare spot of ground the tent is removed to it. The Nootoks, like the wolves, follow up the

reindeer in their migrations and prey upon them, stopping in one place only so long as the food supply lasts.

#### BOATS.

Eskimo oomeaks (open boats) have a frame-work of spruce covered with split walrus hides, sea-lion skins, or white grampus skins; the latter is not used if sea-lion or walrus skins are obtainable, as it is rather thin. The Behring Strait and north coast boats are generally 24 feet long with 5 feet beam, and have a carrying capacity of 15 persons and 500 pounds of freight.

Those of Kotzebue Sound average about 35 feet in length and 6 feet in width. They have a carrying capacity of 20 persons and 1,000 pounds of freight, or 3,000 pounds of merchandise and a crew of six men. There are exceptional boats built on the Sound that are as much as 42 feet over all. In crossing Kotzebue Sound or Behring Strait the natives sew on bulwarks of sea-lion skins a foot high to keep the water from dashing in.

#### NOTE ON ESKIMO BIBLIOGRAPHY.

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A very complete "Bibliography of the Eskimo Language" has been compiled by Mr. James C. Pilling, and published by the Bureau of Ethnology, Washington, D. C. Whoever examines its pages must be impressed with the large number of persons who have unpublished manuscripts, containing from a score to a few hundred words; the large number of printed reports of Arctic explorations, which contain a partial list of words and phrases; and the fact that there is not a single comprehensive English-Eskimo vocabulary in print, and accessible to teachers and others, among the Alaskan Eskimos.

Among the most important in the past are—

Dr. Benjamin S. Barton's Vocabulary of the Greenlander's (from Cranz). 8vo; pages, 132. Pub. Philadelphia, 1798.

Eskimanx and English Vocabulary, compiled by Capt. John Washington, R. N., and published by order of the lords commissioners of the admiralty for the use of the Arctic Expedition in Search of Sir John Franklin. Oblong 12 mo. 160 pages. London. 1850.

English-Aleutian Dictionary prepared by Stephen N. Buynitzky, and published by the Alaska Commercial Company. San Francisco, 1871. 8 vo. 13 pp.

The above are out of print.

The most recent vocabulary that is available is that of Lieut. P. H. Ray, in the Report of the International Polar Expedition to Point Barrow. 4<sup>o</sup>. Washington, D. C., 1885.

This volume gives 711 words and 307 phrases, as used by the Eskimo at Point Barrow.

Perhaps the most important contribution to the Eskimo language is in process of preparation by L. M. Turner, in his observations made in 1882-1884, and will be published in connection with the Signal Service of the U. S. Army.

It will contain a vocabulary of the Koksøagmyut of over 7,000 words; the Unalit of Norton Sound, 3,000 words; the Malimyut, Norton Sound, 250 words; and the Unalashka-Alyut Dictionary of 1,900 words.

|                  |                     |                  |                   |
|------------------|---------------------|------------------|-------------------|
| Break            | Na whik'to          | Cap, gun         | E tik' a rook     |
| Breakers         | Ki luk'tuk          | Cap, gun         | E shaw osti'look  |
| Breast           | Me'look             | Capeize, boat    | Oo me ret         |
| Breast of bird   | Kot'ka              | Capeize, sled    | Keet me ret       |
| Breathe          | An uk ter va'luk    | Capeize, kyak    | Ki ah'rook        |
| Bridge           | Im u op'kwo tah     | Capeize, kyak    | Keen nu'ru        |
| Bright           | Kep luk'to          | Captain          | Oo ma'lik         |
| Bring            | Kok'ito             | Carbine          | Nah chuh'uk       |
| Bring            | I'ro                | Carcass          | Se'lu             |
| Brittle          | Che gok a luk'to ak | Cards            | Kar'tok           |
| Broken           | Na whik'to it       | Cards to pass    | Pah chok'to       |
| Broken, not      | Na whing'e cho      | Cards, to play   | Keh               |
| Broom            | Til a hut'che       | Cards, diamonds  | Too'ne            |
| Broth            | Im'akok             | Cards, hearts    | Etig'aruk         |
| Brother          | Il yug'a            | Cards, clubs     | Ah re gay'luk     |
| Brother, elder   | Nugat che'a         | Cards, clubs     | Se'klokt          |
| Brother, younger | Nook'a              | Cards, spades    | Kop'poon          |
| Brow             | Kowung'a            | Cards, ace       | Choo'cha          |
| Brown            | Ka wek'su ruk       | Cards, king      | Killilleruk       |
| Bruise           | Owng'a              | Cards, queen     | Okan'ok           |
| Bruise           | Ah zhe'ak           | Cards, jack      | Illlegak          |
| Brush            | Shun neok'tuk       | Cards, tens, etc | Same as numerals  |
| Bucket           | Ko lip'se           | Careful          | E ra'ge           |
| Bucket           | Kot tow ruk         | Carry            | Irrarup'kah       |
| Bucket           | Kot'ogah            | Carry together   | Taseoak'took      |
| Bucket           | Ko lip'setik        | Cartridge        | Kok' a rek        |
| Buckle           | Kog'a oot           | Cask             | Me'chuh           |
| Bad              | Kot me yung'oit     | Catarrh          | Nu'whuh           |
| Bug              | In'yuk              | Catch            | Ko hy'at          |
| Bullet           | Kok ru'a            | Catch fish       | Now yo'ok         |
| Bullet-mold      | Koo'vin             | Cave             | E ren'ik          |
| Bull-head fish   | Kob row ote nok     | Celery, wild     | Saz re'gail       |
| Bump             | Pe che kok'to       | Chafe            | Po wit'to         |
| Bundle           | She'lute            | Chain            | Ko li'ora         |
| Buoy             | Pooktow'te          | Chain            | Ka lin'na ret     |
| Burn             | Oo tuk'too          | Chalk            | Ka'te             |
| Burn             | Oo tet tin ate      | Changing         | Tak semur'uk      |
| Burning earth    | E ka ma ro'a        | Charcoal         | Ow'mah            |
| Burrow           | Nip ter'uk          | Charm, talisman  | Ong'mah           |
| Burnt            | E lik se mer'uk     | Chastise         | Oo powtook'too    |
| Bush, edible     | Nowayoi'hut         | Cheek            | Oo loo raken      |
| Bushes           | Ok'peek             | Chew             | Tam o kot'ches    |
| Butt             | To wy' ya           | Chew of tobacco  | O ko me'a         |
| Butte            | Mit ko' a lo        | Children         | Kon neek'toik     |
| Buttes           | Mit ko a lo'ret     | Chim'ney         | E shuh' awik      |
| Butterfly        | Tok a luk'a sah     | Chim'ney         | E che'a           |
| Butterfly        | Chah ah lin' a tuk  | Chin             | Tab lo' a         |
| Butterfly        | Chuk a mik' atok    | Chin tattoo      | Tab lao'tit       |
| Butterfly pupæ   | Ow zre'ok           | Chin labrets     | Too'toks          |
| Button           | Too atow'ruk        | Chisel           | Keya'ek           |
| Button-hole      | Nokto'ak-we'it      | Choke            | Se lan'a          |
| Buy              | Ah ke'a             | Chum             | Ah win'mute       |
| Cache            | Chuk a lo'uk        | Chute            | Tal lu yet        |
| Cache            | Chek a lo'ne        | Circle           | Tuk kowrume       |
| Calf of leg      | Nagot shung'nok     | Clam             | Kah ve'atok       |
| Calico           | Atig'aloo           | Clam             | E va'lo           |
| Call             | Ot'kuh              | Clam             | Um mung'me        |
| Call a person    | Ka o'te             | Claw             | Kook ke'a         |
| Call a person    | Kah ko rah' ah      | Clay             | O'rak-imnu'ok     |
| Calm             | An o'wa-pe'luk      | Clean            | Oo tum'o          |
| Can              | Poke'avy            | Cliff            | Imp'ni            |
| Cancer           | Ahyo'a              | Climb            | Mi uketo'it       |
| Canvas-back duck | Un ut koo'ya        | Cloak, spotted   | Koo neag-ahteg'a  |
| Cap              | Nah ow'a tuk        | Cloak, outer     | Ahtig'a           |
| Cap, gun         | Kob lu'it           | Cloak, inner     | Il n'park         |
| Cap, gun         | Kob'loont           | Cloak, open      | Shabi'uke-ahtig'a |



|                |                   |                      |                       |
|----------------|-------------------|----------------------|-----------------------|
| Battle         | Im'uk'tuk         | Hizzard              | E re luk'chook        |
| Battle         | Ah koo to         | Black and tackle     | An o'ko luk           |
| Battle         | ongave o' whik    | Black and tackle     | Na luk'e'e gah        |
| Battle         | Top a rek to it   | Bluel                | Owk                   |
| Bay            | Im uk'a' rrook    | Blow breath          | Chu bla ok'to         |
| Bayou          | Took'look         | Blow nose            | Kok ik'cho            |
| Beach          | Kah ok tuk'too it | Blow nose            | Kok uhtanga           |
| Bead           | Shung ow'ro       | Blue                 | Tawk rek'to ah        |
| Beak           | Koh a' rroon      | Blue bird            | Ou ko uk tow'ruk      |
| Bean           | Ko morra          | Blush                | Ka rek pul'uk to      |
| Bear white     | Nau'ook           | Boat, open           | Oo me'ak              |
| Bear, brown    | Og alok           | Boat, closed         | Ky'ak                 |
| Bear, black    | E yar'uk          | Boil                 | Kol lek'to            |
| Bear, cub      | Tol lu            | Boil over            | Pe too whok'to        |
| Beard          | Mug'wa            | Bolt                 | Ke ka ok'tit          |
| Beard          | Kog la oot'in     | Bolt                 | Ke lu'ta              |
| Beast          | Tig lu rok toak   | Bone                 | Chal'noh              |
| Beautiful      | Ah re'gay         | Bone, remove         | Chal'noh cho          |
| Beaver         | Pah look ta       | Bonfire              | Ek woff'aro           |
| Bed            | Oo loot           | Book                 | Mop pu'gah            |
| Bed            | Ma loo g'a' nok   | Book                 | Kal le'ket            |
| Beetle         | In'yuk            | Boat                 | Kum'ma                |
| Beetle water   | Nah che'noh       | Boat, bottom of sole | Cho bo'a              |
| Beggar         | Oo ma gil'o       | Boat, deer           | Pin u'kuh             |
| Behind         | Pe chu ru'k       | Boat, deer           | Nal le'it             |
| Believe        | E che'nal o       | Boat, long           | Kom'muk'ip pu'e'chuk  |
| Bell           | Ah kook a' look   | Boat, long           | Akooptuk'ten          |
| Belt           | Tape'che          | Boat, short          | Ni hu'yet             |
| Bend           | Perik'a           | Boat heel            | Kim me'a              |
| Bend           | Na wing'a way     | Boat instep          | Al lo'a               |
| Bend not       | Na wing' chuk     | Boat laces           | Se ne'a               |
| Bermie         | As she'a          | Boat sails           | At tung'a             |
| Bermie         | A se'ret          | Boat tap             | Un'yo                 |
| Bermie, dars   | Se'whot           | Boat upper           | Kong'a                |
| Betrothed      | We a'kok to       | Border               | Ok koo'ra             |
| Between        | Woon a'ye'ok      | Border               | Al e'geet'ko tah      |
| Beyond         | Attan'e           | Bother               | Shu gon na ah gah'tin |
| Big            | Ong a ru'rum      | Bottle               | Toak a la you'ko      |
| Big, very      | Ong a'rut         | Bottle               | Toh a la you tow'ruk  |
| Bird           | Ch mo'ra          | Bottle               | Mish o'ak'to          |
| Birch          | Pah'uk            | Bottle, small        | Mish o'ok tow'ro      |
| Birch          | Ou re'ge'uk       | Bottom               | Nat'hah               |
| Bird           | Ting me'ak        | Bottom               | Nah tal'ga            |
| Bird           | Kah wa            | Box, to shoot        | Pe shik'cho           |
| Birds          | Tung me'ret       | Box, of a ship       | She wa                |
| Birds, nest    | Oo'poo'te         | Box                  | A up'e'kot            |
| Birds, nest    | Se'uk'atik        | Box, small           | A up'e'karook         |
| Bird           | Ou'pook           | Box, very small      | Seu loo'gow'ruk       |
| Bird           | Kog'noh'tit       | Box                  | Il'e'gah              |
| Bitter         | A'kok             | Boys                 | U'ile'yar'guk         |
| Black          | Took to'ok        | Box, half green      | Nugat'pe'giko         |
| Black          | M'ook to'ok       | Bracelet             | Tah e'chet ha         |
| Black, of      | O'ook'ook'in      | Bracelet             | Ta yuh                |
| Black, of      | Took to'ook'et    | Bracelet             | Tah e'ah'et           |
| Black, of, gah | Mik'tuk           | Bracelet             | Ta yak'et             |
| Black, of, gah | Kah'too           | Bracelet, small      | Tah vat'chata         |
| Black, of, gah | M'ook'et          | Bracelet, small      | Tal e'gow'ro          |
| Black, of, gah | N'ook'et          | Brain                | Kok e'chuk            |
| Black, of, gah | Se'ing'ro         | Brain                | Kah ek'tok            |
| Black, of, gah | O'ook'ook'et      | Brain                | Neg'a'leh             |
| Black, of, gah | O'ook'ook'et      | Brain                | Luk'lu'uk             |
| Black, of, gah | Tape'ke           | Brain                | Ch'a'wil'ruk          |
| Black, of, gah | Nat'h'ga          | Brain                | Chu bla'ta            |
| Black, of, gah | Pe'we             | Brain                | Poon'uk               |
| Black, of, gah | K'ok'kum'a        | Brain, hard          | Kok'o                 |
| Black, of, gah |                   | Brain, hard          | Kok'o lah             |

|                  |                     |                  |                   |
|------------------|---------------------|------------------|-------------------|
| Break            | Na whik'to          | Cap, gun         | E tik'a rook      |
| Breakers         | Ki luk'tuk          | Cap, gun         | E shaw outi'took  |
| Breast           | Me'look             | Capsize, boat    | Oo me ret         |
| Breast of bird   | Kot'ka              | Capsize, sled    | Keet me ret       |
| Breathe          | An nk ter va'luk    | Capsize, kayak   | Ki ah'took        |
| Bridge           | Im u op'kwo tah     | Capsize, kayak   | Keen nu'ru        |
| Bright           | Kep luk'to          | Captain          | Oo ma'llik        |
| Bring            | Kok'to              | Carbine          | Nah chuh'uk       |
| Bring            | I'ro                | Carcase          | Se'lu             |
| Brittle          | Che gok a luk'to ak | Cards            | Kar'tok           |
| Broken           | Na whik to it       | Cards to pass    | Pah chok'to       |
| Broken, not      | Na whing o cho      | Cards, to play   | Koh               |
| Broom            | Til a hut'che       | Cards, diamonds  | Tow'ne            |
| Broth            | Im'akok             | Cards, hearts    | Etig'aruk         |
| Brother          | Il yug'a            | Cards, clubs     | Ah ro gay'luk     |
| Brother, elder   | Nugat che'a         | Cards, clubs     | Se'klokt          |
| Brother, younger | Nook'a              | Cards, spades    | Kop'poon          |
| Brow             | Kowung'a            | Cards, ace       | Chow'cha          |
| Brown            | Ka weh'en ruk       | Cards, king      | Killilleruk       |
| Bruise           | Owing'a             | Cards, queen     | Okan'ok           |
| Bruise           | Ah zhe'ak           | Cards, jack      | Illegak           |
| Brush            | Shun neok'tuk       | Cards, tens, etc | Same aa numerals  |
| Bucket           | Ko lip'ee           | Careful          | E ra'ge           |
| Bucket           | Kot tow ruk         | Carry            | Irrarup'kah       |
| Bucket           | Kot'ogah            | Carry together   | Tasooak'took      |
| Bucket           | Ko lip'etlik        | Cartridge        | Kok'a rek         |
| Buckle           | Kog'a out           | Cask             | Me'chuh           |
| Bud              | Kot me yung'oit     | Catarh           | Nu'whuh           |
| Bug              | In'uk               | Catch            | Kohy'at           |
| Bullet           | Kok ru'a            | Catch fish       | Now yo'ok         |
| Bullet-mold      | Koo'vin             | Cave             | E ren'ik          |
| Bull head fish   | Koh row ote nok     | Celery, wild     | Sax re'gail       |
| Bump             | Pe che kok to       | Chafe            | Po wit'to         |
| Handle           | Shi'lute            | Chain            | Ko li'ora         |
| Bury             | Pooktow'te          | Chain            | Ka lin'na ret     |
| Burn             | Oo tuk'too          | Chalk            | Ka'te             |
| Burn             | Oo tet tin ate      | Changing         | Tak semur'uk      |
| Burning earth    | E ka ma ro'a        | Charcoal         | Ow'mah            |
| Burrow           | Nip ter'uk          | Charm, talisman  | Ong'mah           |
| Burnt            | E lik se me'uk      | Chastise         | Oo pow'took'too   |
| Bush, edible     | Nowayon'hut         | Cheek            | Oo loo raken      |
| Bushes           | Ok peok             | Chew             | Tam o kot'chea    |
| Butt             | To wy'ya            | Chew of tobacco  | O ko me'a         |
| Butte            | Mit ko'a lo         | Children         | Kon neek'toik     |
| Buttes           | Mit ko'a lo ret     | Chimney          | E ahuh'awik       |
| Butterfly        | Tok a luk a sah     | Chimney          | E che'a           |
| Butterfly        | Chah ah lin a tuk   | Chin             | Tab lo'a          |
| Butterfly        | Chuk a mik atok     | Chin tattoo      | Tab loo tit       |
| Butterfly pupa   | Ow zhe'uk           | Chin labrets     | Too toks          |
| Button           | Tou atow'ruk        | Chisel           | Koya ek           |
| Button hole      | Noktoak we'it       | Choke            | Se lan a          |
| Bay              | Ah ke'a             | Chum             | Ah wio'mute       |
| Cache            | Chuk a lo'uk        | Chute            | Tal lu vet        |
| Cache            | Chuk a lo'ne        | Cycle            | Tuk kow'rume      |
| Calf of leg      | Nagot shug nok      | Clam             | Kah ve atok       |
| Calico           | Atrig'alo           | Clam             | E va lo           |
| Call             | O'kup               | Clam             | Um mung'me        |
| Call a person    | Koo'to              | Claw             | Kook ke'a         |
| Call a person    | Ko'ko rah'ah        | Clay             | O tal man'uk      |
| Calm             | Atoo ope luk        | Clean            | Oo tum'o          |
| Can              | Poko'sy             | Cliff            | Imp'it            |
| Canoe            | Ah'ka               | Climb            | Mi uk to it       |
| Canvas back duck | Ung'koo'ka          | Cloak, spotted   | Koo nee'ah'teg'a  |
| Cap              | Nu'ow a tuk         | Cloak, outer     | Ahtig'a           |
| Cap, gun         | Koh'out             | Cloak, inner     | Il'up'ark         |
| Cap, gun         | Koh'out             | Cloak, open      | Shah'ouke ahtig'a |

|                   |                    |                     |                    |
|-------------------|--------------------|---------------------|--------------------|
| Clack long        | Tool'uah           | Crab                | Kok'hook           |
| Clack short       | Ah kou ey'took     | Crab                | Nig a rok'puk      |
| Clack heavy       | Chum o'rok'to      | Crab                | E la boy hayet     |
| Clack portion     | Atlagu             | Crack               | Kou neh            |
| Clack portion     | Oos yug'aya        | Crane               | Tah tis a rok      |
| Clack             | Toak tuk toak      | Crane tripod        | Nog'a ruk          |
| Close             | Mahso ret          | Cranky person       | Kig look to ak     |
| Close             | Periktok totin     | Craw                | Poo ye'ga          |
| Closest           | Anok awik          | Craw                | Poo ey'ak          |
| Clot              | Ookwil auk         | Crazy               | Ke nung'a ro a     |
| Cloud             | Kal luk            | Crazy               | Til ki yok         |
| Cloudless         | Kal lo'chuk        | Creek               | Koug ru rok        |
| Cloudless         | Kil la'chuk        | Criap               | E lek'ee mer uk    |
| Coal              | Ala a              | Crook               | Fah ret a          |
| Coatlet           | Kalug a ra         | Crooked             | Al o'ra            |
| Coatlet           | Soo loon           | Crooked, very       | Nal lo ret         |
| Coconut           | Koo ya goot'in     | Cross upright post  | Nuk peruk          |
| Cool              | Og a la now ra     | Cross bar           | On na shet'ner uk  |
| Cold              | Al a pah           | Cross bow           | Kat keelik         |
| Cold intense      | Al a pak toak      | Crossing            | Nok toh leti chon  |
| Cold              | Nok a e lun        | Crossing            | Nok tok to a       |
| Cold at home      | Ku tooka           | Crown               | Ku ro a            |
| Cold              | E la u to          | Crush               | Ou wok'to          |
| Come              | Ky lo              | Crush               | Oulu ga            |
| Come              | Ky wa              | Cry                 | Ke a ruk           |
| Come to it        | Ki ne tik          | Cub                 | Ab a ro tal ik     |
| Come in           | E chuk a'at tin    | Cuff                | Shuk a mit ka      |
| Come in way I     | E chuk a lum'a     | Cup                 | Kale go'wo         |
| Coming            | Ky ro              | Cup                 | Im u go'wo         |
| Coming a spot     | An nun neak'to     | Cure                | Shoo op'toak       |
| Coming to a state | Ky lo ang a        | Curse               | Tow yok sing'oom'a |
| Coming after      | Ki ret tuni ah rah | Curve               | Mung e'chuk        |
| Coming to be      | Kine ak to         | Put                 | In'yo              |
| Compass           | Ang yow            | Put with woman's    |                    |
| Compass box       | Oomuk              | knife               | Oo loo ra'me       |
| Compass box       | Tok to be          | Put with knife      | Oow we'tuk         |
| Compass box door  | Ko ka re'tik       | Put with scissors   | Chae'gah           |
| Complotted        | Oo gun uk tuk      | Put up I            | E rok se lung a    |
| Conceal           | Ong yow            | Put you             | E rok se lu tin    |
| Conceal           | Sou yok to it      | Daffodil            | Ma lu kut tow ro   |
| Conceal           | Kanuk ra           | Dam                 | Pa uk tit          |
| Conceal state     | Ko ya'ook          | Damp                | Mok luk            |
| Conceal           | Ni wo'tka          | Dance               | Po a la rah        |
| Conceal           | Nu mo'o            | Dance               | Po a la ra         |
| Conceal           | Og a'at tik        | Dance of exhaustion | It ki lo'ah ro     |
| Conceal           | E ga'at ka         | Dark                | Tauk to ak         |
| Conceal           | Ook'au'et          | Dark very           | Tauk to ak puk     |
| Conceal           | Ook'au'            | Darken              | Tauk toot'in       |
| Conceal           | Ki'au'ook          | Darken              | Tal nok            |
| Conceal           | Ook'au'ok          | Darken              | Na kou she ak'to   |
| Conceal           | Ki'au'ok'k         | Dark                | Na le'gah          |
| Conceal           | U'au'ook           | Daughter            | Pun a              |
| Conceal           | Ki'au'ook          | Daughter            | Pun a'a            |
| Conceal           | Og a'at ka         | Day                 | Oo blupuk          |
| Conceal           | Ni wo'tka          | Daylight            | Oo bluk            |
| Conceal           | Po'au'ok           | Deal                | Toak o'ro          |
| Conceal           | Pu'au'ok           | Deal                | Nuon a'au'ik       |
| Conceal           | Ni wo'tka          | Deal                | Toak tuk           |
| Conceal           | Ni wo'tka          | Deal                | Ou tin             |
| Conceal           | Ki'au'ook          | Deal                | E tik to'ang'a     |
| Conceal           | Ni wo'tka          | Deal                | E shoo'te          |
| Conceal           | Ki'au'ook          | Deal                | Toak'te            |
| Conceal           | Ki'au'ook          | Deal under          | Oo ke'ulik         |
| Conceal           | Ki'au'ook          | Deal under          | Oo pun rah me      |
| Conceal           | Mi'au'ok           | Deal white          | Kou'ne'g           |
| Conceal           | Pu'au'ok           | Deal young          | No'whuk            |

|                  |                   |                   |                        |
|------------------|-------------------|-------------------|------------------------|
| Deer horns       | Nog'ar uk         | Drill month-piece | Nok'aru                |
| Deer, buck       | Pung'nek          | Drink             | Im uk'to               |
| Deer, running    | Pun el ik'to      | Drink             | E chu'ga               |
| Deer fat         | Kown'ok           | Dripping          | Koo'chuk               |
| Deer excrement   | On'nte            | Drop              | Ir upe kah ah          |
| Dallency         | Tou ping'a        | Dropped           | Ir upe kwok'to         |
| Departed         | Ah wik to'ak      | Droway            | E yah ara rung'nah     |
| Depopulated      | Noon a re'a       | Drum              | Sow yung'a             |
| Depth            | E tip chung'a     | Drum              | Sow'yok                |
| Desert           | Okok che re cho'a | Drum              | Kil' yown              |
| Desist           | At'a              | Drum-stick        | Moom wa' a             |
| Devil            | Toon rok          | Drunk             | Imus'a-uktung'a        |
| Did              | Tuz'ra            | Duck, widgeon     | An a ve'a              |
| Difficult        | Shung'e rook      | Duck, crowbill    | Ot'pah                 |
| Dig              | Kah ve ok'to a    | Duck, elder       | A mow'lik              |
| Dig with pick    | Se klokt o'a      | Duck, elder       | Me'tik                 |
| Dipper           | Kol'la            | Duck, elder king  | King' a lik            |
| Dipper           | Ky'ata            | Duck, young       | Ok peen'ik             |
| Dipper           | Im o'ga           | Dull              | E pik'tuk              |
| Dipper           | Kol'let           | Dust              | Cho plok'towah         |
| Dirty            | Wah'ak            | Duster            | Til a hut'che          |
| Dirty, not       | Wan'e cho         | Dwarf             | Inu'vok-utting'ok      |
| Disappeared      | Pe yik'tin        | Dye, red          | E nang ne'ak           |
| Dialke           | On me shook'too   | Eagle             | Ting meak'puk          |
| Distant          | Ah'pl             | Ear               | Se'tik                 |
| Distemper        | Mul a kul'a ro    | Ear of animal     | Se uke'tat             |
| Divide           | Ah too ga'wah     | Ear-ring          | Poo'too                |
| Divorce          | Chav o' a         | Earth             | Noon'a                 |
| Dizzy            | E ring'ru rok     | Earthquake        | Noon'a-koo pe'ruk      |
| Do               | Pe la'ruk         | Earthquake        | E boo ro'a             |
| Do it            | Ke'a              | East              | Ki wunt'nuk            |
| Down             | Nat koh'a lik     | East              | Ke vung'nuk            |
| Down here        | Ta kun'a          | East              | Pah mung'nah           |
| Do you know?     | Il u weet so'a    | Eat               | Ne ah'rook             |
| Deck (vegetable) | Al lu'a kut       | Eat               | Now a yok'to           |
| Deck (vegetable) | Ku ut'le rok      | Eat               | Nek a yok'to           |
| Deck (vegetable) | Kaw'kut           | Eat, wish to      | E ying'ye ok           |
| Deck, small      | Eat'pik           | Edge of a board   | Ege le'kret            |
| Deck, small      | Se'rel            | Edge of a blade   | Ke eng fi ung'a        |
| Doctor           | I'n nt'kout       | Eel               | Kob loy'ek             |
| Doctor-house     | Un nt'koo'a       | Eight             | Ping i'ahu-okving'i lo |
| Doctor-house     | I'ngah u luk'it   | Elastic           | Iu u pe'a              |
| Dog              | King' mek         | Elastic           | Kush'uk                |
| Dog pup          | King meah rook    | Elbow             | E kou che'ga           |
| Dog pup          | Ke mow'good       | Empty             | Noo woot'ka            |
| Doll             | In uno wok        | Enciente          | Nar a chok'to          |
| Dome             | Tuz'ra vah        | End               | E'chook                |
| Don't know       | At'chu            | End               | E cho'a                |
| Don't know       | Kan o'me          | Endway            | Tal ing'nara           |
| Door             | Mopto'rok         | Enemy             | Tal oke'ne ruk         |
| Door-mat         | Al o kie'on       | Enemies           | Tal loke whate         |
| Dorsal fin       | Chung ho          | Engine            | Ow la'ta               |
| Double           | Ta pete'lok       | Enough            | Tuz'ra                 |
| Down             | Nat koh'alik      | Enough            | As in'o                |
| Down here        | Ta kun'a          | Ensnare           | Se uk sow'te tik       |
| Down there       | Kah von'a         | Enter             | E chin'a               |
| Down in          | Shum mun'a        | Entered           | E chuh in              |
| Drag             | On ne ah ah       | Entering          | Ko he'wik              |
| Draw or write    | Oga late          | Entrails          | Il gow'we              |
| Drawers          | Ah'kok            | Erase             | On le'rok              |
| Dream            | Senatoaktou na    | Even              | Ah le me't're gook     |
| Drum             | Go ye ga'ya       | Evening           | A koo'puk              |
| Dried            | Panek ta          | Evening star      | Nun'nek                |
| Drift            | Teep'sret         | Every one         | Il u hut in            |
| Drill            | Ne uk'toon        | Exceedingly       | Ok too' ret            |
| Drill-handle     | Pe ahik'ne rok    | Excellent         | Na koo pe yak'to       |

|                  |                   |                    |                         |
|------------------|-------------------|--------------------|-------------------------|
| Extremement      | On'ok             | Fish-pole          | A bah lu ha'ta          |
| Extremement      | Pook chah'tuk     | Fish-pole          | Mun'uk                  |
| Exhort           | Kat chug'a        | Fish-net           | Ko'bra                  |
| Extinguished     | Kom mit'kon       | Fisours            | Oak sung'ok             |
| Eye              | Erit              | Five               | Tal e ma                |
| Eye-brow         | Kuh lunt          | Five of them       | Tal e man'ik            |
| Eye-lid          | Kim me go it      | Flag               | Tok'o yo                |
| Eye, open        | Erit mo' chuk     | Flag               | Ow let'ha               |
| Eye-glasses      | Ere gah           | Flag               | E la'le                 |
| Eye of a needle  | Egra              | Flag-pole          | Na pay'oke              |
| Face             | Ke nowk           | Flame              | E pir a vo'a            |
| Face             | E chook'to a      | Flapping           | Se ek ru it'ta it       |
| Fail             | Peuk pah          | Flat               | E la'che                |
| Failed           | Peuk to ak        | Flattened          | E la tum'ne             |
| Fail             | Kiyaw ro          | Flaw               | E ke che'tit            |
| Fail over        | Olirok            | Flea               | Puk la ya'uk            |
| Family           | Nal ma at         | Flesh              | Nek'a                   |
| Fan              | Pat koo tak'took  | Flint              | Kook'chook              |
| Far              | Oon a sik'took    | Flint              | Koo wuk'sruk            |
| Fast             | Shuk a sho a rone | Flint-scraper      | Ung'mah                 |
| Fasten           | Nu o go ty cho    | Flint-dresser      | Kig le                  |
| Fat              | Ook aruk          | Flipper            | Chit'kwo                |
| Fat person       | Ko tu u rusk      | Flirt              | Ang a chuk a chuk'cho a |
| Father           | Ah pa             | Floor              | Nat'tah                 |
| Father-in-law    | Ong a vo kong'ek  | Floor              | Nat'choet               |
| Fathom           | E chug'neh        | Floor              | Noo kah'ah              |
| Fear             | Hah ne'ta         | Flour              | Ky u cha'ok             |
| Fear             | E ta'tok          | Flower             | Me lu kut'a             |
| Feasted          | E kehe as         | Flukes             | Chok'puk                |
| Feather          | Mut kowa          | Flukes             | Ah ki'chung             |
| Feather          | Mit kook'uk       | Flute, with teeth  | Ke'ret                  |
| Feed             | Tap pe chuke      | Flute, with needle | Mun'ek'chuk             |
| Fest             | E to gite         | Fly                | A nok'uk                |
| Feldspar         | Alie gro          | Fly                | Na lu'ga ret            |
| Female           | Ok an'ok          | Fly, blue-bottle   | Oob a u'buk             |
| Few              | Amo'ok tun        | Fly, blue-bottle   | Nib a u'buk             |
| Fight            | I g a lo a        | Fly, r.            | Ting'a ro               |
| File             | Pu yah a go'ra    | Foam               | Kap oot'lok             |
| File             | Pe now'gan        | Fog                | Tap tik'to              |
| File             | Pu yow'a          | Fog                | Tap took'took           |
| File             | A'vok'ok          | Fog horn           | Kook ti'took            |
| File             | Ag'ok'ok          | Foggy is           | Tap aha'why             |
| File             | Pu yow'k'oung a   | Following          | Tum'e rah               |
| File             | Tak'ha'it         | Fool               | Tit'k'ok                |
| File             | Puk'ok'k'aga      | Foolish            | Ke tung ok'to           |
| Find it          | Pat'ok'ang a      | Foot               | Tig go'tit              |
| Fine weather     | N'p'ok'took       | For                | Oon e'le                |
| Finger           | Tak'ok            | Foreign            | In u'pe'a               |
| Finger           | Kat'ok'ok         | Forget             | Pe wuk'to               |
| Finger           | M'ok'ok           | Fork               | Na crane                |
| Finger 4         | E ta'ok'ok        | Fork, table        | Kok'ek'tit              |
| Finger, thumb    | K'ok'ok           | Fork, table        | Koo'ek'tit              |
| Finger, index    | K'ok'ok           | Fork, creek        | Kong'een                |
| Finger, middle   | Pu'ok'ok          | Four               | Se sam'at               |
| Finger, ring     | Pu'ok'ok          | Four of them       | Se sam'an'ik            |
| Finger, little   | Pu'ok'ok          | Fox blue           | Ke en ruk'tu m          |
| Finger, pink     | Na'ok'ok          | Fox red            | Ky'ok'to                |
| Finger, white    | Ke'ok'ok          | Fox, white         | Kook'ok'ok              |
| Finger, yellow   | Pe'ok'ok          | Fox, white         | Pe'ok'ok'ok             |
| Finger, black    | Ke'ok'ok          | Fox, white         | Ko'ok'ok                |
| Finger, silver   | Ke'ok'ok          | Fox, white         | Te'ok'ok                |
| Finger, gold     | Ke'ok'ok          | Fox, white         | Ki'ok'ok                |
| Finger, iron     | Ke'ok'ok          | Fox, white         | E'ok'ok                 |
| Finger, steel    | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, copper   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, tin      | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, lead     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, zinc     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, nickel   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, platinum | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, silver   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, gold     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, iron     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, steel    | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, copper   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, tin      | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, lead     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, zinc     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, nickel   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, platinum | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, silver   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, gold     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, iron     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, steel    | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, copper   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, tin      | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, lead     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, zinc     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, nickel   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, platinum | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, silver   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, gold     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, iron     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, steel    | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, copper   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, tin      | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, lead     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, zinc     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, nickel   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, platinum | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, silver   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, gold     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, iron     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, steel    | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, copper   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, tin      | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, lead     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, zinc     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, nickel   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, platinum | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, silver   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, gold     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, iron     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, steel    | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, copper   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, tin      | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, lead     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, zinc     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, nickel   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, platinum | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, silver   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, gold     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, iron     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, steel    | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, copper   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, tin      | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, lead     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, zinc     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, nickel   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, platinum | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, silver   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, gold     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, iron     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, steel    | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, copper   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, tin      | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, lead     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, zinc     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, nickel   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, platinum | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, silver   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, gold     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, iron     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, steel    | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, copper   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, tin      | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, lead     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, zinc     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, nickel   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, platinum | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, silver   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, gold     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, iron     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, steel    | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, copper   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, tin      | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, lead     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, zinc     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, nickel   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, platinum | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, silver   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, gold     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, iron     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, steel    | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, copper   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, tin      | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, lead     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, zinc     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, nickel   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, platinum | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, silver   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, gold     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
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| Finger, steel    | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, copper   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, tin      | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, lead     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, zinc     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, nickel   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, platinum | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, silver   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, gold     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
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| Finger, copper   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
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| Finger, lead     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, zinc     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, nickel   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, platinum | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, silver   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, gold     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, iron     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
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| Finger, copper   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, tin      | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, lead     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, zinc     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, nickel   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, platinum | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, silver   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, gold     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, iron     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, steel    | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, copper   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, tin      | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, lead     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, zinc     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, nickel   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, platinum | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, silver   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, gold     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, iron     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, steel    | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, copper   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, tin      | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, lead     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, zinc     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, nickel   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, platinum | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, silver   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, gold     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, iron     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
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| Finger, copper   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, tin      | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, lead     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, zinc     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, nickel   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, platinum | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, silver   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, gold     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, iron     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
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| Finger, copper   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, tin      | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, lead     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, zinc     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, nickel   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, platinum | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, silver   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, gold     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, iron     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, steel    | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, copper   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, tin      | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, lead     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, zinc     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, nickel   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, platinum | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, silver   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, gold     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, iron     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, steel    | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, copper   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, tin      | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, lead     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, zinc     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, nickel   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, platinum | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, silver   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, gold     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
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| Finger, copper   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, tin      | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, lead     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, zinc     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, nickel   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, platinum | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, silver   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, gold     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, iron     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, steel    | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, copper   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, tin      | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, lead     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, zinc     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, nickel   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, platinum | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, silver   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, gold     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, iron     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
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| Finger, copper   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, tin      | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, lead     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, zinc     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, nickel   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, platinum | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, silver   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, gold     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, iron     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, steel    | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, copper   | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, tin      | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, lead     | Ke'ok'ok          | Fox, white         | Ke'ok'ok                |
| Finger, zinc     |                   |                    |                         |

|                 |                       |                                                  |                      |
|-----------------|-----------------------|--------------------------------------------------|----------------------|
| Frash           | Ke le'pra             | Good                                             | Na koo'ra            |
| Friend          | Nu i gi'lu            | Good, not                                        | Na kwe'chuk          |
| Fringes         | Ke ok tow'ra          | Goose, black                                     | Lik lin now'ro       |
| Fringes, skin   | Nig er ah toot'ka     | Goose, white                                     | Kang'oot             |
| Fringes of hood | E cheh'a wik          | Gooseberry                                       | Luk u e yak e rook   |
| From            | Ah wan'e              | Gossip                                           | Ne put'e ro it       |
| Frost           | Am o'kwol             | Grampus, white                                   | She to'ak            |
| Frost           | Ah'poon               | Grampus, white                                   | She sho'ak           |
| Frost-bite      | Ke ret'te gah         | Grandfather                                      | Too ti lo'a          |
| Frost bite      | E zre ko'ak           | Grandmother                                      | At ti'loo            |
| Frost fish      | Kal loo'ret           | Graphite                                         | To ko ro mo'tok      |
| Frost fish      | Kal o'at              | Graphite                                         | O rok'na kow         |
| Frown           | Kun u le'rok          | Graphite                                         | Min'uno              |
| Frozen          | Kwawk                 | Grass                                            | Pe nik srait         |
| Frozen          | Se ku ne'ruk          | Grave                                            | Kom'moke             |
| Frozen mist     | Tat'too               | Grave                                            | Kom'mook             |
| Frozen limb     | Ke ret'ta             | Gravel                                           | Kah oe'a             |
| Fry             | Pe chik che lek'to ak | Great bear ( <i>ursus mar-</i><br><i>joris</i> ) | Too a tow'ruk        |
| Frying-pan      | Pah chik che tan      | Green                                            | Shung ok'to ak       |
| Fugitive        | Out la'rek            | Grindstone                                       | Ah ge'ok             |
| Full            | Seel a wik to         | Grindstone                                       | Me u'it              |
| Full of life    | Ah kim nok'to ak      | Grip                                             | Ah zre gug'luk to ak |
| Fun             | Kou'lu                | Gristle                                          | Na tak ko'ak         |
| Future          | Oo blak o             | Groin                                            | Na wik kung'a        |
| Gale            | An o wa'kah           | Grooved                                          | Ko'kut               |
| Gale            | An o wa'wah           | Grow                                             | Og lan a ok'to       |
| Gall            | Shung'wah             | Grow                                             | Now'ro               |
| Gall            | Sung'ah               | Gull, black (jaeger)                             | E chung'mok          |
| Gap             | Chow ne               | Gull, black head                                 | Kook'a ru            |
| Gargle          | Oo e al'ego           | Gull (burgomaster)                               | Now'yak              |
| Gasp            | Nug a bok'to ak       | Gull, black-tip wings                            | Nat chan a bar'o     |
| Genial          | Ah nu na cho'ak       | Gull, young                                      | Cha ret'ke ga        |
| Gesture         | Wam it'in             | Gums                                             | E kit'ke             |
| Gist            | Pe'le go              | Gun                                              | Shu'poon             |
| Get out         | Owk se lah            | Gun, 44 Winchester                               | Cha wil'ik           |
| Get out         | Oo ma shook'toong a   | Gun, 45 Winchester                               | Cha wil'ik puk       |
| Get out         | Chu ru ok'o ne        | Gun, 45 Hotchkiss                                | A now ti'lek         |
| Get out         | Oo ma gib'o           | Gun, rifle, Henry                                | E ke me a'lik        |
| Ghost           | Ek che ro'a           | Gun, Sharp's                                     | Oo chow rel'a        |
| Ghost           | Too noo ri'ok         | Gun, carbine                                     | Ni shu'ra            |
| Giant           | Kille                 | Gun, shot-gun                                    | Kok a poy ok'toon    |
| Giggle          | Ig lat o'ro a         | Gun, shot-gun                                    | Mon ya la rek'toon   |
| Gill            | Mur'she               | Gun, shot-gun, Rna-                              | Shou poot a gow'ro   |
| Giri            | Nu go uk'euk          | slan                                             |                      |
| Giri            | Ok an ow'rok          | Gun, firing pin                                  | Oo shuk shug'a       |
| Give            | I took                | Gun barrel                                       | Shoop ru'a           |
| Give me         | I che'me              | Gun barrel                                       | Toob loo'a           |
| Give back       | Kol n na              | Gun cover                                        | Shoo poot'e po'gah   |
| Give, I         | Ong e gootlu          | Gun extractor                                    | Nik she ag'a         |
| Gizzard         | Nat moo La            | Gun guard                                        | Kok a la go'ra       |
| Glad            | Pe let to roak        | Gun hammer                                       | A now tung a         |
| Glass           | Mik ook to ak         | Gun hammer                                       | Ka roo'tuk           |
| Glow-worm       | Poo gwok so a hoy'ak  | Gun magazine                                     | Alo rung'a           |
| Glove           | Ah zre gite           | Gun muzzle                                       | Pung'a               |
| Glutony         | Mup po wa'ga          | Gun nipple                                       | Chu plu'ru           |
| Guaried         | Pow a wek'to          | Gun ramrod                                       | Pow la'yo            |
| Guash           | We la'ruk             | Gun sight                                        | Lah low tig'a tow    |
| Gumee           | Ok a ru rok           | Gun sight, hind                                  | Muk tow go'tow       |
| Gumee           | Ka'te                 | Gun spring                                       | Pe shik she'rok      |
| Go              | Ah yok to             | Gun stock                                        | Ke ru'a              |
| Go back         | I ne ak'to            | Gun trigger                                      | Pok e yung a         |
| Going, I am     | Ah yung ne ak'to      | Gun wad                                          | Me lig'a rok         |
| Going inland    | Pan nang ne ak'to     | Hair, of head                                    | Nu'ya                |
| Going, we are   | Ah lang ne ak'to      | Hair, of animal                                  | Mit'noon             |
| Going home      | Ah nut. ne ak'te go   | Hair, of body                                    | Ting'e               |
| Gone            | Ah lok'to             |                                                  |                      |

|                   |                         |                  |                         |
|-------------------|-------------------------|------------------|-------------------------|
| Half              | Ah wig a luk'puk        | Hill             | E'het                   |
| Half              | Attun'e a wig a luk'puk | Hill             | Yo o'net                |
| Half              | Ke pin'na yah           | Hip              | Kat pag' a              |
| Half              | Ke'pah                  | Hip              | Cho ve ah'ga            |
| Half of a thing   | Iglupe a                | Hip              | Ke'cho                  |
| Hammer            | Kow woo'te              | Hia              | E'lan                   |
| Hammer            | Kowt                    | Hia              | Oo sing'a lo            |
| Hammer            | Kuz ru'tok              | Hit              | Tig a look'a            |
| Hammer            | Kuz'rate                | Holsted          | Pan'a                   |
| Hand              | Ah'v'gite               | Hold             | Tig u'ga                |
| Hand in hand      | Tasse oak'took          | Hold             | Te u'ga                 |
| Hand to me        | Tam u't'cho             | Hole             | Puo to'a                |
| Handle, r.        | Te kume ve'a            | Hole, torn       | A lik'uk                |
| Handle of knife   | U'poo ruk               | Hole, torn       | Al'eh                   |
| Handle of ax      | U'po a                  | Hole in ground   | Nip teruk               |
| Handle of scraper | Ool ge'lik              | Honest           | Tig a la nte'chah       |
| Handsome          | Ne tang e'ronk          | Hood             | Naah'oon                |
| Hand              | Ne win nok'took         | Hoof             | Mik'a                   |
| Hang up           | Kok it kah              | Hook             | Kek a sru'ok            |
| Happy             | Kou yol gor'chetin      | Hop              | Now ye rok tuk          |
| Hard              | Te ek to ak             | Horizon          | Al on'ok                |
| Hard wood         | Eek k'ik                | Hot              | Oo n'p'ke               |
| Hare              | Oo kal'ik               | House            | Ig a la                 |
| Harlot            | Chung uk'too ruoka      | House traders    | Ig a lu'puk             |
| Harness           | An'oot                  | House, summer    | Tuo'pik                 |
| Harpoon           | Ma el ro                | How              | Kom'mo                  |
| Haw               | Ta kum a-pe gah         | How much or many | Kap sin'ik              |
| Has been          | Ta kum a-se meruk       | Howl             | Ma goo'ruk              |
| Hasten            | Ok a yok e a'voo        | Hug              | Ye k'ik'a               |
| Hat               | Naah a to'cha           | Hungry           | Ne ar a chuk teung'a    |
| Hatch             | Pa'ya                   | Hungry           | Na ka chuk'loon a       |
| Hatchet           | Ole ma gow'ruk          | Hungry           | Kah'cha                 |
| Hatchet           | Kot la pow'rok          | Hungry           | Kah'tu'a                |
| Hate              | Oo me chook too         | Hunter           | Tou we'het              |
| Hatred            | Tou yo yok tu tin       | Hurry            | Shuk kel'ly             |
| Have              | Kok tit                 | Hurry            | Shup kwet'uk            |
| Hawk grouse       | Kis ra gow'ik           | Hurt             | Ar ah                   |
| Hawk, marmot      | Kil tua                 | Hurt             | Nin nok'te              |
| Hawk, marmot      | Kil'roh                 | Hut              | Tou puk'a rook          |
| Hawk, bird        | Kis ra gow'ik ok        | Husband          | Oo wing'a               |
| Haze, tease       | Nu ve ro'it             | Husband          | Oo we'ga                |
| Hazy              | Nip t. lua              | I                | Oo wunga                |
| He                | E'lah                   | I have           | Kok it'ko'ne            |
| Head              | Ne a ko ko              | I am uncertain   | Kan o'me                |
| Headache          | Ana nok tu              | Ice              | Se ku                   |
| Heel              | Te shi ro               | Ice-cream        | Al lupeto ak            |
| Heart             | Chimuk                  | Ice-pike         | Teag                    |
| Heart             | Chimut a                | Ice-pressure     | E too ru'ak             |
| Heart             | Chimut a                | Ice-scratch      | As e'gown               |
| Heart burn        | Kun nok to'ak           | Ice-flaw         | E ke che'tet            |
| Heaven            | Kong'ok                 | Ice-icle         | Kun chu'le gah          |
| Heaven            | Kong'ok                 | Idle             | Sav a ak chu'ng teung a |
| Heavy             | Oko ma'cha              | Ill-tempered     | Kap sha'rook            |
| Heel              | King'uk a               | Immovable        | Sin'ik                  |
| Hell              | To'kood to'ak           | In               | Kah mun a               |
| Help              | Pu wat'ing              | Indifferent      | Shung'e cho             |
| Help              | Nu la w'ok to           | Intercourse      | Kou'gala pe lu          |
| Hen               | Ok an a se'la           | Intercourse      | Kou va gun ta           |
| Her               | E'la                    | Intercourse      | Ke ke ko ag'a lo        |
| Hers              | ee'lyat                 | Inside           | Il y'ne                 |
| Hers              | La'm'ne                 | Inverted         | Lo'ruk                  |
| Hers to w         | Mu'ra                   | Iron or steel    | Chow'wik                |
| Hew               | Oo'la ma'ra             | Is for           | Oon'a                   |
| Hi enough         | E'chou'cha'uk to        | It is there      | Fu'ra oh'pe             |
| High              | Muk a'han a             | Island           | Ka kek'tah              |
| High tower'ng     | King'ik'took            | Is               | E'lah                   |

|                  |                     |                       |                    |
|------------------|---------------------|-----------------------|--------------------|
| It               | Oo'kwah             | Large                 | Ong a sru'rum      |
| It is            | Pe la'ruk           | Larva                 | Ow ya'rek          |
| It is done       | Tux ru'va           | Leashings             | No ming'a          |
| It is snowing    | Konik'takah         | Later                 | Munt ne's go       |
| It was           | Muzrago's           | Laugh                 | Ig'a lok           |
| Itch             | Kil'yo              | Laughing              | Ig a lok'to        |
| Jab              | Toak'to             | Lazy                  | E ka chook'toong a |
| Jade             | Kok sook'to         | Lead, v.              | Tak sew'wa         |
| Jar              | Ko he'wik           | Lead, n.              | Kok a ru'rok       |
| Jaw              | Tam o'whotik        | Lead                  | O'whok             |
| Jaw              | Wan eto'ak          | Leaf                  | Ma loo'ga tuk      |
| Jealous          | Chung nayok'to      | Leaf fat              | Kown'ah            |
| Jelly-fish       | Ippeah'ro           | Leaf tobacco          | Kou ver a'cho      |
| Joint            | Am Ba ga            | Leaf tobacco, long    | Shu rok a ro'mo    |
| Jump             | Minutok'to          | Leaf tobacco, Russian | To oak a pe'a      |
| Jump up and down | On u a wetok'to     | Leak                  | Oo win'a gow       |
| Keep time        | Ah moo tin          | Lean person           | Pun now'ro         |
| Kettle           | Oo kon che'te       | Leaning               | Ki yo'ro           |
| Key              | Keloochuk           | Leap                  | Nish o gok'tuk     |
| Kick             | Ah rok'to           | Leather               | Ah kob'a le grok   |
| Kidney           | Dokto's             | Leave                 | An ning            |
| Killed           | Toaktomo            | Leer                  | E ret keet'ka      |
| Killed           | Shoaker'o           | Left                  | Kun nez'reae       |
| Killed           | Ta koot'ka          | Leg                   | Nuke               |
| Kiss             | Ke ma ke'ta         | Lend                  | Ah tuk'to a        |
| Kitchen          | E'jah               | Let go                | E pe'gown          |
| Kits             | Pa room'a           | Let go                | E pung'a           |
| Knee             | Muk'nik             | Level                 | Mum ok'to          |
| Knee             | Nob a lute'ka       | Lever                 | Ka pe'go an        |
| Kneel            | Chate kong'aron     | Lever                 | E pouk'ta          |
| Knee-pan         | Chate ko'a          | Lick                  | Al look to'a       |
| Knife            | Chow'wik            | Lie                   | Chuk'loo           |
| Knife, woman's   | Oo loo'ra           | Lie, I                | Chuk lu ru'ne      |
| Knife, pocket    | Pinutok             | Lie, you              | Chuk lu'rutin      |
| Knife, pocket    | Pinuktow ro         | Lie, not              | Chuk loo'ne cho    |
| Knife, pocket    | Pin ek'ta           | Lie down              | In ok'to           |
| Knife, pocket    | Tob a ta'too        | Lie down to sleep     | Sin ik shok'to     |
| Knife, pocket    | Tapik topto'a       | Lift                  | Ke wik'a           |
| Knife, skinning  | Kavingaro's         | Lift me               | Ke win me gah'me   |
| Knife-cut        | Chow wik'tuk        | Light                 | Ik ne a'to         |
| Knock            | Tik'loo             | Light weight          | O ka chu'ruk       |
| Knot             | Kal luk in          | Light, very           | Wolt tuk           |
| Knot             | Iluk a              | Light, very           | Wolt tu row'nek    |
| Knot in tree     | Ah kweh'a           | Light, very           | Ka na ak se rnk    |
| Knot in tree     | Ekaro               | Lightning             | Ik'nek             |
| Know             | Il eech e nung egah | Limb                  | Ah a yate          |
| Know not         | Nel a ru'a          | Limber                | Tik sow'mine luk   |
| Know not         | Nel a we ga         | Limp                  | Shu shog ip pok'to |
| Knuckle          | Negib li boy        | Line rope             | Ok lu'nah          |
| Labrets          | Tov'toka            | Living                | Il u pah ung'a     |
| Ladder           | Men hos te          | Lip                   | Kok a lo'a         |
| Ladle            | Kok are             | Listen                | Ah tut'a           |
| Ladle            | Kog a ruru'ma       | Little                | Min ig arum'ik     |
| Lagoon           | Tash uk             | Little                | Mik a sru'ruu      |
| Lake             | Narra vok           | Live                  | In yo'rok          |
| Lake, large      | Na pes k            | Live                  | An uk'toot         |
| Lame             | Ship shi lok        | Live                  | Yoke'a lu          |
| Lamenting        | Ke a ru a           | Liver                 | Tin'ook            |
| Lamp             | Nan uk              | Lock                  | Ah yoke'kwolk      |
| Lamp chimney     | Kow look in         | Lotty                 | King ik'took       |
| Lance            | Ke la tuk too       | Loina                 | Pe'kwah            |
| Land             | Noon a              | Lonesome              | He ah'rook         |
| Land otter       | Pim ma uk tuk       | Long                  | Tuk'a zrook        |
| Lap              | Kok to kok e        | Loom, of an object    | Ou'wee't           |
| Lard             | Ook'a ruk           | Loom                  | Kok so'it          |
| Large            | Ong a zroak         | Loom                  | Kok a ro'it        |



|                     |                        |                     |                       |
|---------------------|------------------------|---------------------|-----------------------|
| Loon king           | Too'lik                | Mitten              | Ite kot e ka          |
| Lost                | Tam nk to'a            | Mitten              | Ite'kua               |
| Lost                | Pat che ang'a          | Mole, lemming       | A win yate            |
| Lost, not           | Pat kon'e'cho          | Mole, pimple        | Oup'tuk               |
| Loud                | Nip'pe                 | Monkey-wrench       | Ore'yowk              |
| Louse               | Koo'maik               | Month {             | Tat keb               |
| Love, I             | Na ko og'a ra          | Month }             |                       |
| Love, you           | Na ko ag a gin         | Moon, new           | Nu hoi'a no           |
| Lump                | Ok lum'ok              | Moon, first quarter | Naw ak'tuk            |
| Lung                | Poo'wah                | Moon, full          | Im ug e'lik tik'tea   |
| Lustful             | Palig'er ak tow tin    | Moon, last quarter  | Ke mook to            |
| Lynx                | Nu to va               | Moon, old           | Tat ke lang se ak cho |
| Mad                 | Kim nung a ro a        | Moon, 1st phase     | Ok me ang u'e'te      |
| Mad                 | Kun'ook too            | Moon, 2d phase      | Ab a tok'pa           |
| Maggot              | Koo'maik               | Moon, 3d phase      | Ok leet'took          |
| Magnifying glass    | Kim u'gah ro           | Moon, 4th phase     | Ok me a'h loh'te      |
| Maid                | Nu le ak che'a         | Moose               | Too tok'wok           |
| Make                | Se vak to              | More                | Shu lay               |
| Male                | Ong'oon                | Morning             | Ah kuh'go             |
| Male                | A yoon                 | Morning star        | Og'a ro               |
| Mammoth             | Ke lig'a huk           | Morsel              | Chu lu pe'toak        |
| Mastodon            |                        | Mosquito            | Kik to ate            |
| Mastodon ivory      | Ke lig kom nok se go'a | Mosquito, long      | Nu e yok a rook       |
| Man, native         | In'ke                  | Moss, sea           | Nuy a ra ke           |
| Man, white          | Na lah mute            | Moss, fuel          | Mon'ook               |
| Man, white          | Tan'ik                 | Moss, reindeer      | Ok me'e'chat          |
| Man, white          | Koh loona              | Moss, reindeer      | Ne kaht               |
| Man, negro          | Taw'ka loo rum         | Moss, berry         | Se'whot               |
| Man, old            | Ong a vo kog nek       | Moth                | Mal u'go uk           |
| Man, native, plural | In'weet                | Mother              | Ah ka                 |
| Marine spoke        | E're gown              | Mother              | Ah kah ga             |
| Marmot              | Seek arek              | Mother in law       | Ong ung uk            |
| Marrow              | Pot'ka                 | Motion              | Ow la tin             |
| Marrow of bone      | Pot ka tol nok         | Mountain            | E'het                 |
| Marry               | Pig'a                  | Mountain            | Ok men                |
| Marry               | Nu'ook ket'ook to      | Mountain sheep      | Imp na'ok             |
| Marten              | Kip we to ak           | Mountain sheep      | Too too imp'ni        |
| Mask                | Ke'nowk                | Moose, brown        | Poo'kok'tit           |
| Maat                | Napak tit              | Moose, brandle      | Ke'lon nu tik         |
| Mat                 | Top ka hato            | Moose, gray         | Ok gru'noh            |
| Matches             | E'koet't               | Month               | Kal to kin            |
| Match safe          | E'koet'ta              | Move                | Ol la ro              |
| Mat                 | E'galu                 | Move off            | Ow lum e              |
| Mate                | Nu'ping a              | Multitude           | In u ba'ook'took      |
| Mattress            | E'koet'ta              | Mushroom            | Ah'vook               |
| Mattress            | Ok wung a              | Mushroom            | Ah te'gah'en yak      |
| Meadow              | Oup'at                 | Mussel              | Yaw hoo te            |
| Meat                | Nu'ka                  | Mussel              | Ah tut e gal'uit      |
| Meat                | Ok ka                  | Mus instrument      | Ah tuk'atong          |
| Meat                | In'weet                | Mus instrument      | Ah tuk'too'ra         |
| Melrose             | Ong'ok'took            | Musket              | Ok mung'mong          |
| Melrose extract     | Ong'og'a'toa           | Muskrat             | Ke'p gal'lape         |
| Melrose extract     | Ok te'ke'took          | Mushin              | Nas ra'vok            |
| Melrose             | E'galu                 | Musket              | Ah'vok                |
| Melrose             | E'galu                 | Musket              | Ab'vok                |
| Melrose             | A'g'o                  | Musket              | Ok muk'tin'e          |
| Melrose             | Nu'p'ook'took          | Musket              | Ok me'nek             |
| Melrose             | A'g'o'tok              | Musket              | Ok brow tit           |
| Melrose             | Ok'ak'took             | Musket              | Ok waptin'a           |
| Melrose             | Ok'waptin'a            | Musket              | Ke'pal'uk             |
| Melrose             | Ke'pal'uk              | Musket              | Ke'kak                |
| Melrose             | Nu'p'ook'took          | Musket              | Ting ung'a            |
| Melrose             | Tat'ok'took            | Musket              | Ok kuh                |
| Melrose             | Star tit               | Musket              | In'a lo               |
| Melrose             | Nu'lo to               | Narrow              | Ok'too'rot            |
| Melrose             | Ok'hot'ek a            | Naval               | Ke'eecho              |

|                       |                         |                     |                   |
|-----------------------|-------------------------|---------------------|-------------------|
| Near                  | Konik'to                | Old woman           | Ok a u og'a rook  |
| Near                  | Kon atu'ra              | On                  | E'to              |
| Nech                  | Kong ashe'nek           | On                  | In im ne'a        |
| Neck                  | Kong ik she veeng'a gab | One                 | A tow'shek        |
| Need                  | Pe shook kel awk'to     | One of them         | A tow'she me      |
| Needle                | Mit'koon                | Onion               | Now yate          |
| Needle                | Mitkoot'agana           | Onion               | Too pit too'u it  |
| Needle-glovers        | Pun el'uk               | Only                | Ke she'me         |
| Needle-glovers, fine  | An mik cho'a            | Open                | Oo moo ey'kluk    |
| Needle-glovers, large | She lik to'a            | Open                | Oo mo uk'kuk      |
| Needle, round, fine   | Ko og'rulik             | Open                | E ta'ke           |
| Needle, round, large  | Ko og zret'ton ik       | Opera-glass         | E reh'a ro        |
| Needle-case           | E ya me'ga              | Opera-glass         | Kin u ok'tuk      |
| Needle-case           | Too zhum'ok             | Opposite            | Mutte'roo         |
| Needle-cushion        | Too'loo                 | Orca (killer)       | Ah'a lute         |
| Negative              | Ne gung'a               | Orphan              | Il e ah'a rook    |
| Neglect               | Much amok'to            | Ostracise           | Enner'o'a         |
| Nephrite              | Echig'nok               | Other               | Ot'la             |
| Nerve                 | Oto'uke                 | Ours                | Oo wung'a loo     |
| Net                   | Ko'bra                  | Out                 | On'e ru           |
| Nettle-rash           | Pin u roo'a             | Out of the light    | Pe yik'in         |
| New                   | Nu'tok                  | Outside             | Kong ing'a        |
| Night                 | Oong nah'puk            | Outside of house    | Seel'a mon        |
| Night                 | Oong'nah                | Outside of house    | Seel ya tan'a     |
| Nights                | Too noo'nek             | Over                | Ko ling'a ok      |
| Nine                  | Ko ling otal'a          | Overcloak           | Kap'e tok         |
| Nipple                | Ne loong'a              | Owl, white          | Ook'peek          |
| Nit                   | Ik'kik                  | Owl, young          | Ook pe'gi lo      |
| No                    | Nah'ga                  | Owl, brown          | Ik na sa ik       |
| No, will not          | Pe'chuk                 | Owl, brown          | Ik na sa a hoy'ik |
| No more               | Pi luk'tuk              | Owl, long ears      | Too ta'u let      |
| Nod                   | Na yung'a               | Owl, small brown    | Ah'tok            |
| Nodding               | Na yung okto            | Paddle              | An oo'it          |
| Noise                 | Ah vo'many              | Paddle              | Ok'o              |
| None                  | Pete pa la'ruk          | Paddle              | Ak'koon           |
| None                  | Pete pi'ruk             | Paddle              | Ong a wok'to      |
| None                  | Pe ne latin             | Pain                | An nu tok         |
| North                 | Nega                    | Paint               | Na'noon           |
| North                 | Ne'yak                  | Pair                | Tak er o'a        |
| Noose                 | King ok'a               | Pale                | Me cheet che'uk   |
| Noose, big            | Moong a kok to ro a     | Palm                | Oo too'muk        |
| Nostril               | Natut kwo'a             | Pan                 | Pin'n loo         |
| Not anything          | Pete pe yak to          | Pantaloons          | Kum'a             |
| Not desired           | Pe chung'e cho          | Pantaloons          | Nel a kow'ruk     |
| Not enough            | Ne kip cak to           | Pantaloons, short   | Kok'le            |
| Not enough            | Mok lu'it               | Pantaloons, woman's | She'ra leag       |
| Not good              | Pe lu                   | Paper               | Mop'po gite       |
| Not here              | Pe luk                  | Paper               | Og a la nok       |
| Notch                 | Ke pil a gang'a         | Parasol, wild       | Mush'o            |
| Now                   | Puk nom my              | Pass on mountains   | Im ate'kon        |
| Now                   | Puk mah                 | Past ages           | Hi pah'ne         |
| Now here              | Mun'e                   | Pastime             | Hi pah'go         |
| Nozzle                | Koo'wa                  | Path                | Too'mit           |
| Nurse                 | Tig a tu ah ga          | Pearl               | Im aik'to ak      |
| Oar                   | E jo'ra                 | Pelvis              | Hing'i            |
| Ocean                 | Ou na ne                | Pencil              | Og la'nah         |
| Ocean                 | Eoy o'ne                | Pencil              | Og'low'n          |
| Of                    | A'go                    | Peninsula, Alaskan  | Im ah ok          |
| Off                   | Pah ne                  | Pepper              | Ken yak roon      |
| Off                   | An                      | Perished            | Me tuh            |
| Oil                   | Ook a rook              | Periwinkle          | Ha goo'na         |
| Oil                   | Ook sruk                | Phalarope           | Ok vil a tum'ik   |
| Oil stove             | Ke lip cheh a wik       | Phalarope           | Chav'ok           |
| Old thing             | Oo too'kok              | Phalarope           | Owg ro'a          |
| Old man               | Ong a yo kog'ara        | Pick (tool)         | Se klokt          |

|                     |                      |                   |                         |
|---------------------|----------------------|-------------------|-------------------------|
| Pick up             | Tig a shu'rok        | Present           | Pig's ren               |
| Pickle              | Kong'a look          | Press             | Nat kut/ka              |
| Picture             | Og'a late            | Pretty            | Ah re/ga                |
| Piece               | Ow e ka              | Prickly           | Ip kol nek'te           |
| Pieces              | Ap wook'to           | Primers           | Ik na gram'ik           |
| Pike (fish)         | She                  | Piarmigan         | Kah'way                 |
| Pike (fish)         | She'ook              | Piarmigan         | O ka're gaik po ah'took |
| Piling up           | E roo voo'uk         | Piarmigan, hooded | Ok es re gow'ik         |
| Piling              | E be'ruk             | Puberty           | Wing ik to'ak           |
| Pill                | Il n'oun             | Puffin            | Ko lung'ek              |
| Pillow              | Ah kin               | Pull              | Neek a to'ya            |
| Pimple              | Kig'lik              | Pull              | Che ung'a roo           |
| Pincers             | Kom e gowa           | Punch (rivet)     | Ko ka gowa              |
| Pinch               | Pe u'ka              | Punk              | Ap pi'te                |
| Pinch               | Hoo mon ok to ak     | Pup               | King me ah'took         |
| Pin feather         | Maw na               | Pup               | Ko moog'ood             |
| Pipe                | Cha'nek              | Purple            | Tung uk'to ak           |
| Pipe                | Che na'ya            | Purifiers         | Onik'hik                |
| Pipe, fancy         | Ko in'yok            | Push              | Shoo poo loo'a          |
| Pipe cleaner        | Chu ba la'ta         | Put               | Shun'na                 |
| Pitch or toss       | Nah luk'ate          | Pyrite            | Ik' nek                 |
| Plant               | Pil gi'rok           | Quack             | Ka toak'took            |
| Plane               | E'koon               | Quick             | Kal a man'ik            |
| Plane               | E luk too'ak         | Quill             | To tak sro'gah          |
| Planing knife       | Mik'hik              | Quit              | A'va                    |
| Planing knife       | Ky u'ta              | Radish, wild      | Kwik'nek                |
| Platform            | E keh'geet           | Raft              | Koo a whok'tis          |
| Play                | Al lay chook'toong a | Rain              | She la'took             |
| Plenty              | Am a lok'tuk         | Rainbow           | Too loo'muk             |
| Plenty              | Am a li tuk          | Rainbow           | Oov wan'uk              |
| Plover              | Naahat to olik       | Rainbow           | Chaw'ne                 |
| Plover              | E rez go vrak        | Raining           | She la look'te          |
| Plover, black belly | E lak tel'ik         | Raiser            | Mi uk'to                |
| Pocket              | Ek a we              | Ramrod            | Pow la'yo               |
| Pocket              | Eag a we e kin       | Rapid             | Kel u ro'ak             |
| Pocket              | Kaw ma wi it         | Rapids            | Tap ka'nito             |
| Point n             | Tig a rah'ah         | Raven             | Too loo'a               |
| Point e             | Ong a na nok         | Raw               | Ah ook'chook to a       |
| Poise               | Pe took kah'took     | Razor             | Pik che'in              |
| Poke air bag        | Tug a ro'pok         | Read              | Chah ok'tuk             |
| Poke air bag        | Ah tok pok           | Ready             | Ah min'oft              |
| Poke air bag whole  | Ah wuk tok pok       | Recently          | Ikth'rok                |
| Poke air bag        | Pook'oruk            | Receptacle        | Pong'ra                 |
| Pole                | Az u tok to          | Red               | Ka rek che'ak           |
| Poor person         | Heak pok             | Reflection        | Ta kunga                |
| Poor person         | Heak chuk            | Reflection        | Tok'ha                  |
| Poor food           | Pan tik too'tin      | Reloading tools   | Cha vow'te              |
| Popgun              | Shoo poo wa          | Reloading tools   | Kok a rotik             |
| Popgun              | E lak ka'ook         | Reloading tools   | Tout'ik                 |
| Popgun              | King ok a look       | Remaining         | Ong a yang'ik po        |
| Popgun              | E lip koo'tok        | Remember          | La'bet                  |
| Pot                 | Pe gab               | Remove stake off  | Pe a lo'go              |
| Pot                 | Kok'pa               | Return            | Ou uk'took              |
| Pot                 | Oot koo'chik         | Returned          | Oo toktin'e             |
| Pot                 | Li bi'lik'ah         | Reverse           | Le'rek                  |
| Potato              | Oot koo              | Revolver          | Ik lo per'e             |
| Potato              | Pot koo't            | Rib               | Too loo'mo              |
| Potato              | Se a to              | Rice              | Navakor'a               |
| Pouch               | Li loo'ka' to        | Rich              | Ooma'la                 |
| Pour                | Koo ve'ga            | Riding            | Ko ug'aru               |
| Pour                | Koo'va               | Right             | Ah kun'ale              |
| Pour down           | Chuk che'la'ra       | Right side        | Oo whily'ga             |
| Pour out            | Koo'va               | Rim               | Ah mo'chuko             |
| Powder, str. ash    | E kang a roo         | Ring              | Katuk aluu'a            |
| Powder              | Ok a ru'chuk         | Ring              | As ka mo'tak            |
| Powder dash         | Ok a ru'chute        | Ringworm          | Ne gow'a                |

|                           |                   |                       |                          |
|---------------------------|-------------------|-----------------------|--------------------------|
| Rise up                   | Ok ah'pat         | Scoop out             | Ky u'ta gan              |
| River                     | Kook              | Score (20)            | Ke'pe ak                 |
| Rivet                     | Ke ha ik'ok       | Scrape                | E kook'tookin            |
| Rivulet                   | Keeg ru'rok       | Scraped               | E kung'agoa              |
| Road                      | Ap kwot'e         | Scraper               | E'koo                    |
| Road                      | Al'e              | Scratch               | Kitcho'a                 |
| Road                      | Ap'kon            | Scratch               | Cha uke chu ahchu'na     |
| Rock                      | Oo yaw'ek         | Screw                 | Na katowigota            |
| Rock                      | Oo yaw'wite       | Scruff                | Cho a me'ma              |
| Rocks                     | Oo yaw'tuk        | Sculpin               | Koneyo'ok                |
| Rock tower                | Oo kee'ok         | Sea                   | Oo na'ne                 |
| Roof                      | Chu'wa            | Sea urchin            | Ik pe ak'ru noy          |
| Roll, n.                  | Ki'tuk            | Sea quail             | Ok pol'uk                |
| Roll, v.                  | E moo'gwah        | Sea quails            | Ok pala'rot              |
| Rooster                   | Ok suk'to         | Seal, banded          | Eah'wuk                  |
| Root                      | Ayoon eel'a       | Seal, banded          | Ky roll'ik               |
| Root, substitute for food | Nu'ma             | Seal, common          | Ma'chik                  |
| Rope                      | Ah'wa             | Seal, thick skin      | Oog'a rook               |
| Rope, pass me             | Ok lu'nah         | Seal, leopard         | Ka'cho gal'k             |
| Rope is off               | Ok lunok'noot'me  | Seal, sinew           | Na loo'a                 |
| Rotten                    | Ok low'rok        | Seal, blow hole       | Od lu'it                 |
| Round                     | Te'pe             | Seal, baptism of dead | Nat chum'ok              |
| Rub                       | Ke op'kok         | Seam                  | Kelo'a                   |
| Rub                       | Ahik'chu          | Seasons past          | Nipah'ne                 |
| Rudder                    | Telal'frigin      | Seated, be            | Okavoo'tin               |
| Rug                       | Ah ko'ta          | See                   | Kin ya go                |
| Rule                      | Kyo ko'tik        | See                   | Tow'took                 |
| Run                       | Leet teh'uk       | Sell                  | Ahke'chuk                |
| Ran                       | Ok pek'to         | Send                  | Ah wukt echah'tin        |
| Ran behind                | Ma lik sok'tuk    | Servant               | Kape'gab                 |
| Running water             | Shokawok'tit      | Setting hen           | Evar'ok                  |
| Rust                      | Kal'ik            | Seven                 | Tal'ema-malro'nik        |
| Rusty                     | Kalikmeem'uk      | Seven stars           | Sheroop'satuk            |
| Sack                      | Kal uk'tah        | Seven stars           | Se kup'chaituk           |
| Sad                       | Eche mal'otuo     | Sew                   | Kilayok'to               |
| Saddle, venison           | Oo kwet'a         | Sew                   | Kil look'to              |
| Said                      | Oo kwok'ton       | Sew                   | Meg a ruk'toa            |
| Sail                      | Ting a la'tok     | Sew, double seam      | Mal'okillu'it            |
| Salmon                    | Ah kal oo'rok     | Sew, palm and needle  | Seat'mon                 |
| Salmon                    | (h) kwad lu'okpuk | Sewed                 | Killa yung'arus          |
| Salmon, humpback          | Amek'tit          | Sewing                | Kle ya noktu'na          |
| Salmon-trout              | Ah kal oo pik'pye | Shad                  | Seelook'took             |
| Salmon-berries            | No'what           | Shadow                | Kok'etate                |
| Salt                      | Toy'oke           | Shadow                | Tah ah oak               |
| Salt water                | Toy'oke           | Shadow                | Tob'na                   |
| Salt meat                 | Tuo to'a lo       | Shake                 | Ow let'ka                |
| Same                      | Ty mun a          | Sharp                 | E op'ke lup              |
| Same as that              | Ty muwah'sing     | Sharp knife           | Chow wep'kelup           |
| Sand                      | Kahve'a           | Sharpen               | Keu uk shuk'tuk          |
| Sand-piper                | Kal a'o           | Sharpen               | Ke pektol'ago            |
| Sand-bar                  | Tap'kok           | Sharpen               | E pik chol'ago           |
| Sand-stone ball           | Eluk'tuk          | Shave                 | Oo me'ya                 |
| Sat                       | Aknopukaloo'ra    | Shavings              | E va guo'tit             |
| Saw, n.                   | (h) kwok'tonou    | She                   | Ok an'ok                 |
| Saw, v.                   | Oo kook'a         | Sheath                | Ke na le'tok             |
| Scab                      | Ah me'a           | Shell                 | Oo wil'u                 |
| Scabies (to weigh)        | (h) ku ma etah'ga | Shell, flat           | Ma lu gwituk             |
| Scallop (shell)           | Nw yak'i'ya       | Shell fish            | Im an'e                  |
| Scalp                     | (h) kung'wa       | Shin                  | Kin ah'aruok             |
| Scar                      | Ka la'uk          | Shin                  | Kin ah'ga                |
| Scar                      | Kil ya gow'a      | Ship                  | Oo meak'puk              |
| Scare                     | Hah ne'tah        | Shipwreck             | (h) meak'puk-shuk'ametuk |
| Scissors                  | Chal'le-kt        | Shiver                | Ka ip'ka                 |
| Scissors                  | Mal o gow'rume    | Shiver                | Oo lik'to'a              |
| Scissors                  | Male to gow'tak   | Shoot                 | Shoo prutil'ago          |
|                           |                   | Shoot                 | Pe tik'te                |

|                |                    |                |                       |
|----------------|--------------------|----------------|-----------------------|
| Short          | N'ehuk             | Small          | Ko no ah'wa           |
| Short          | Ni shoo'ra         | Smile          | Ig low up ahuk'cho ak |
| Shot, n        | Kok a ro'ah        | Smoke          | E'cho                 |
| Shot           | Kog ru'ek          | Snail, sea     | Beha look'a yok       |
| Shoulder       | Too'e gah          | Snake          | Nu mug'ah             |
| Shoulder blade | Ka ad'ga           | Snare          | Ne'yuk                |
| Shoulder strap | Kuh yoo ta         | Snare          | Toak a look'ahok      |
| Shove          | Pe kok'tin         | Sneeze         | Tog a yuk'puk         |
| Shove in       | Ko he wik          | Snipe          | Koo'a luk             |
| Shovel         | Noo'ah             | Snipe          | I vuh'uk              |
| Shovel         | Piet'moon          | Snipe          | Tal ig'o wait         |
| Shovel         | Pig'oot            | Snore          | Ko mot'uk             |
| Snow           | Tow'took           | Snow, fallen   | A'poon                |
| Shrimp         | Ig le'a            | Snow, fallen   | Ah ne ah'poon         |
| Shrimp         | Ig ne'ek           | Snow, falling  | Kon eek'cho a         |
| Shrimp         | Now lan'ok         | Snow house     | An'e yok              |
| Shroud         | Poong a            | Snow house     | An nu'yuk             |
| Shrubbery      | Ok peek            | Snow house     | An a we'chuk          |
| Shut           | Oh mig le ta       | Snow house     | Ap'e yok              |
| Shut door      | Oh mig le po       | Snow blind     | E ga look'to          |
| Shut up        | Eek tut            | Snow-bird      | A mud'luk             |
| Sick           | An a nah           | Snow-bird      | A mow tok'puk         |
| Side           | Kat'che            | Snow-bird      | Oh ke uh tow'ra       |
| Side           | Shan o kok         | Snow-bird      | Ah what tal e gow're  |
| Sideway        | Ik a yuk to        | Snow-shoes     | Tage look             |
| Sigh           | An ukta puk to     | Snow storm     | Kon eek'puk to        |
| Silly          | Ok wuk to ro'a     | Snow drift     | Kap e gah             |
| Silver         | U'ehuk             | Snowing        | Kon eek'a rah         |
| Sineu          | Ewaloo             | No             | Munt'na               |
| Sineu          | E ya lu            | Noap           | Ye kok'noon           |
| Sing           | At toluo           | Noap           | Me al o               |
| Sink           | Ke veru a          | Soft           | Uvek to               |
| Sister         | Ni ya              | Soft soil      | Ok a ru a             |
| Sister         | Ni yung            | Soften         | Ke ruop to'ak         |
| Sister         | Nook a             | Sole           | At tunga              |
| Sit            | In eek to nek      | Some           | Oh'va                 |
| Sit            | Ok u we'tu         | Song           | At tra lu             |
| Sit            | Ok yim le          | Sons           | Eh a vanga            |
| Six            | Ah chaga ret       | Soot           | Pow la                |
| Six of them    | Ok un le ne        | Sore           | Kil ya                |
| Skates         | Ky ya yar til loot | Sored, wild    | Konga look            |
| Skeleton       | Ton nook           | Sorry          | Kot tunga go ra       |
| Skin, human    | Oh win'ok          | Sound, or gulf | E lu                  |
| Skin, animal   | Ah me              | Sound (noise)  | Ah tuk'kwos           |
| Sky            | Kot lu it          | Soup           | Im a kok              |
| Sky            | Ke'uk              | Soup           | Al loo ra             |
| Slap           | Eh a rok           | South          | Omug a luk            |
| Slate          | Oh'nek             | South          | Oh md'luk             |
| Slate          | Tan tal'ok         | Span           | At lik a chan         |
| Sled           | Oh ne et           | Speak          | Kan'ah                |
| Sled dog       | Kon mo'te          | Speak          | Al'a lah              |
| Sled dog team  | Oh a rook tuk      | Spear, bird    | Moo e yat'ing         |
| Sled team      | Ton men eat        | Spear, seal    | Muk set'uk            |
| Sleep          | Shuk               | Spear, seal    | Tee'ka                |
| Sleeping       | Shuk to            | Spear, seal    | Took'pe               |
| Sleet          | Mo shu'look        | Spear, whale   | Now'a luk             |
| Sleeve         | Icha a             | Speckled       | Ko koud look          |
| Sleeve         | Ira a lu           | Speckled       | Og lek to'ak          |
| Slice          | Ku va to'ak        | Spectacles     | E rok'a rah           |
| Slice          | U le'veto          | Spectacles     | E sro'gah             |
| Slice          | Eh'ek              | Split          | Koo vete              |
| Slippers       | Pin u ra           | Split          | Oh lek'ahuk           |
| Slip, to act   | Koo va to          | Spout          | To'pe-ke'srook        |
| Snowball       | Tash uk            | Spoon          | Al le'ok              |
| Slung shot     | Uw ya              | Spoon          | Al le'ok              |
| Small          | Mik'ro             | Spots on moon  | In uue op hwe'tah     |

|                 |                     |                     |                     |
|-----------------|---------------------|---------------------|---------------------|
| Spotted         | Kat ek to a tik     | Sunrise             | Noo'a rok           |
| Spout of whale  | Oo nang'ne rah      | Sun dog             | Ne ge uk'tuk        |
| Spread          | Man o che'nek       | Suspenders          | E ka re'chek        |
| Spring (season) | Pun noog'a rook     | Suspenders          | No ak a la o'ta     |
| Spring (season) | Oo pun ruk shuk     | Swallow, or similar |                     |
| Spring of water | Kal en'ok           | bird                | Toy u'nek           |
| Spy-glass       | Toak'a lo           | Swallow             | Eel'a wo            |
| Square (tool)   | Ook'toon            | Swallowed           | Eel a ok'pe         |
| Squat           | Ok vil'a to         | Swan                | Koog ru'it          |
| Stab            | Men'uh              | Swan                | Koog'rook           |
| Stain           | Im u'ta             | Sweat               | Oo nuk'ja ka me     |
| Staircase       | Ke lo'a luk         | Sweat               | Kis ze oak'tuk      |
| Stake           | O yah'i             | Sweat dance         | Kis re guk'tuk      |
| Stale           | Ow re'a             | Sweep               | Til a oon'a         |
| Stamp           | Kee'tme tuk         | Swelling            | Pu wit'to a         |
| Stand           | Nuk koovuk          | Swelling            | Il goke chik'cho ah |
| Star            | Oo blu'a ok         | Swim                | Poo grat'to it      |
| Star-fish       | Ah re ga'luk        | Swing               | Ow la'rok           |
| Star-fish       | Og ra o'it          | Table               | Nek'a wik           |
| Start           | Ma lik'pale         | Table               | Ne koo'wik          |
| Stay            | Kin na nok'to       | Tag (a game)        | On oo ke'ga         |
| Steal           | Tig'a lik           | Tag (a game)        | Oo lap kit'ke a     |
| Stream          | Poo'yuk             | Tail, bird          | Pup'ke              |
| Steam launch    | Ik nel a gow'ruk    | Tail, animal        | Pam my oo'ga        |
| Stem (vessel)   | Ah ko a             | Taluted             | Tip'late            |
| Stick, v.       | Ne pe'to            | Take                | Tig'goo             |
| Stiff           | Oo ma rok           | Take                | Tig a ak tu'a       |
| Stiff           | Tik a ya'rok        | Take                | Tik a we'a          |
| Stiff           | Tik sow mer uk      | Take down           | E nok ot'tu a       |
| Stiff           | Nok'te ru           | Take from           | Aht e'ga            |
| Stiff           | Ke took'a cho ak    | Take up             | Te u me uk'tuk      |
| Sink            | Ke ne ok'to         | Take away           | Ah vung'a           |
| Sir             | Ow la'vo            | Talk                | Oo kwok'to          |
| Sir             | Ah kup'ka           | Tallow              | Pood nan'uk         |
| Stocking        | At toad lok         | Tan                 | Eet kil ak a rook   |
| Storking        | Al tik a lo ne      | Tassel              | Nig er'ah           |
| Storking        | Pin u kun ik        | Tattoo              | Tah la o'tit        |
| Stocking        | Al lik'ee           | Tea                 | Ne uk'kwuk          |
| Storking        | Pin u bok           | Tea                 | Chy                 |
| Stomach         | Nar a kwok          | Teapot              | Neuk ko'mo          |
| Stomach-ache    | Nok'a e lun         | Teat (rend)         | A lik'tah           |
| Stoop           | Pol uk'tuk          | Tears               | Te'ya               |
| Stop            | Ah'kun              | Tease               | Kil yo're           |
| Stopped up      | Ong ne a            | Teeth               | Ke ru to            |
| Stove           | Ik nek a wik        | Teeth               | Te kru'tit          |
| Stove pipe      | Poo et yek a wik    | Telescopic glass    | Toh ro a            |
| Strait          | Mal o tik lona      | Telescopic glass    | Toh lo a            |
| Strap           | Nat too tung a      | Temple              | E go we're          |
| Strap           | Nau ma tah          | Ten                 | Ko'let              |
| Straw           | Kok rate            | Ten of them         | Ko lin ik           |
| Strike          | Shuk a mit'ka       | Tent                | Too pik             |
| String, twine   | Min ok'took         | Tent                | Halap'kar           |
| String, leather | E chook             | Tent flap           | E tik to'a          |
| Strip           | Koo po go ke ga     | Teinugant           | Ah gung a ro a      |
| Stripe          | Che vol go't        | Turn                | To ret ko'yak       |
| Strong          | Shung'e rook        | Turn                | Mit ko ti luk       |
| Stubborn        | Ah gung a to'a      | Tetter              | Ne koo'yah          |
| Subsaison       | Am ne ah ru tit     | Thank               | Ko yan o            |
| Suck            | Kok to me ok'to gab | Thank you           | Ko yan ot tu'a      |
| Sugar           | Kap se tak          | That                | Tum'na              |
| Summer          | Oo pun rok          | That                | Oo kwah             |
| Summer          | Oo pun yug a ra     | That is it          | Ta muz ra           |
| Summer          | Oo pun rah          | That one            | Tah room a          |
| Summer fur      | Shog ok             | Than                | Ook se mer'uk       |
| Sun             | Shi kin'ya          | The                 | Im ne a             |
| Sun             | Mer'ank             | Them                | Tap'kwo             |

|                     |                        |                    |                  |
|---------------------|------------------------|--------------------|------------------|
| There               | Oo wee'no              | Towel              | Ek'mano          |
| These               | Tap'kwo                | Tower              | Oo kee'ok        |
| They                | Oo'kwah                | Town               | Tee'pukoru'ti    |
| Thick               | Muk too'ruk            | Track              | Tee'may          |
| Thick               | Ib bu're               | Tracks             | Tee'men          |
| Thick weather       | Mun ok'to              | Trade              | Tauk'no          |
| Thief               | Tig a lik to'a         | Trade              | Ah ke'chuk       |
| Thigh               | In a o'muk             | Transparent        | Kit he aie'ken   |
| Thigh               | Ki u'e                 | Trap               | Mun ne'rook      |
| Thimble             | Tig'a                  | Travail            | Nib in a ro'ak   |
| Thimble             | Tig'aga                | Travail, difficult | Im neche'twa     |
| Thin                | Shat tu ruk            | Tree               | Na pak'took      |
| Thin                | Shat'tu                | Tree climbing      | An a nek toak    |
| Thin                | Muk too'ka chuk        | Tree creeper       | Ty'a             |
| Things              | Ot lum'ok              | Trout              | Oo kwad lu'puk   |
| This                | Oo'va                  | Truly              | Chuk lee ne'cho  |
| This side of        | Ne ahe'no              | Truth              | Chuk in le'uk    |
| Thong               | Ah'lik                 | Truth              | Chuk in'rok      |
| Thone               | Tap'kwo                | Tab                | Oo vek'to        |
| Thone               | Oo'kwah                | Tumble             | Oo lag'le lok    |
| Thread              | Oo wal'oo              | Tumor              | Ob'a rah         |
| Thread              | E ya'lu                | Turbot             | Natah'took       |
| Thread, intestine   | Yogowtik'ook           | Turbot             | Natang'ook       |
| Three               | Ingiahute              | Turbot             | Ik kah'neelook   |
| Throat              | Toopt u're ken         | Turf               | Mun'e it         |
| Throbbing           | Toak tuk to'ak         | Turn               | Teem'ago         |
| Through             | Pah wan'e              | Turn around        | Pawa'neruk       |
| Throw               | Pe yuk'ook             | Turn back          | Teem'atin        |
| Throw               | Oo to ka               | Turn forward       | Ki neehah'tin    |
| Thumb               | Komb'loo               | Turn over          | Ok choleh'to     |
| Thunder             | Ke lo ok ru it         | Turn from          | Mow ne show tin  |
| Thus                | Munt na                | Turn from          | Mu me ok'to      |
| Tickle              | Ke in uk tu'ma         | Turn my            | Te'room          |
| Tide water          | Toak hook              | Turn upward        | Ki ya'ta         |
| Tired               | Chuk a ah chuk         | Turn your          | Tu ra'tin        |
| Tired               | Minoak took            | Twine              | Kwip'ook         |
| Titulate            | Ah kah'took chok to ah | Twist              | Kie pik'chia'tin |
| Tobacco             | Topam'a                | Two                | Hi'pah           |
| Tobacco plug        | Kiwik ta               | Two                | Ma'ho            |
| Tobacco, Russian    | To pan ik pe'a         | Ugly               | Nek a weok'tin   |
| Tobacco, Russian    | Kot leet topam'a       | U'lee              | Ke he'wik        |
| Tobacco, chew       | Uwe'lah                | Unbalanced         | Nu ok'aha rook   |
| Tobacco, chew       | Oo ka riav'a           | Uncertain          | Kan e me'ho      |
| Tobacco, leaf       | Shu roka ro'mie        | Uncle              | Kang a yang'me a |
| Tobacco, smoke      | Ti'om, tu'ute          | Under              | Ke wek'to ah     |
| Toboggan            | Chuk cho'ok to'a       | Undo               | An uk'cho        |
| Toboggan            | She to whok tif        | Undt               | Il'a'lek         |
| Today               | Oo blu'puk             | Unroll             | Oo shoo gwit'ka  |
| Too big             | Pootoo'go              | Unseen             | Tow toong'ik pe  |
| Too big             | Kuob'om                | Untie              | Ung a wil'kin    |
| Too big             | In am'ine              | Untie              | U'a ob're gi     |
| Too cool            | Ano le'ok puk          | Unwell             | An'a nah         |
| Too cool            | Oo'Wak'o               | Unwind             | Ne lep'toon      |
| Too cool            | Oo'kok                 | Up                 | Mi yu'le         |
| Too cool            | Oo'wa                  | Upright            | Nuk pak'tee      |
| Too cool            | Chavante               | Upright            | Nuk pe'e         |
| Too cool            | Nata'a                 | Up and down        | Le'rok           |
| Too cool            | Ko'lo'ra               | Up to there        | Mo chok'to tin   |
| Too cool            | Al'ik'to               | Urine              | Kw're            |
| Too cool            | To let'ko              | Us                 | Oo wang'oot      |
| Too cool, to handle | E ga'le a cha ga       | Valley             | Kut he ne'e ot   |
| Too cool, to handle | E ga'le ke chona       | Vanish             | At a shoot'cho   |
| Too cool, to handle | Nuk ping'a             | Vapor              | Pee e yu'k to    |
| Too cool, to handle | E shone                | Vein               | Tah'uk           |
| Tough               | Te up'e tuk            | Veneral            | Nek e rook       |
| Towel               | Im a'yo                | Veneral sore       | Ke lik'cho       |

|                   |                    |                  |                  |
|-------------------|--------------------|------------------|------------------|
| Ventibule         | Pah                | Whale fin        | Ak lik'o na      |
| View              | Ito                | Whale fin        | Tal ik'hu it     |
| Village           | Ig'a lute          | Whale head       | Che og'ua        |
| Violin            | Kil'ow             | Whale jaw        | Mep'lo gok       |
| Violin            | A le'ta            | Whale meat       | Mak'tuk          |
| Vine              | King'muh           | Whale spout      | Ah sung'ne rah   |
| Vine              | Kik kaig'gow ro    | Whale spout-hole | King'ah          |
| Vine              | Ow'a rok           | Whale tail       | Chok'peek        |
| Vine              | Kig'e tik          | Whale tail       | O war'rok        |
| Vint              | An uk'ta           | Whale vent       | Oo shug'ok       |
| Volcano           | Ik ne shek'a rook  | Whalebone        | Sho'kok          |
| Volcano           | Ik neeshog'a rook  | What             | Chu              |
| Vomit             | Mak ik'cho         | What             | Shu'ma           |
| Waisf             | Ka te'rah          | Wheel            | Ok shuk'to       |
| Wak               | Nan ak'o           | Wheel            | Og a ra lu't     |
| Wait a little     | Un ak'kun          | When             | Shu'pen          |
| Wake up           | E tug'a shaw       | Where            | Nah              |
| Walk              | Pe shu'ru          | Where            | Mah'me           |
| Walked            | Pe chu nok'to ak   | Where            | Nan'ne           |
| Walking           | Pe shu ok'to       | Whetstone        | Moo ho'ya        |
| Walrus            | I'wok              | Whetstone        | Neet'leo         |
| Walrus tusk       | Too'wa             | Whetstone        | Seed'le          |
| Walrus tusk       | Too war'uk         | Whetstone        | Ah yeh'ok        |
| Wand              | Ke lli'rook        | Which            | She              |
| Want              | Pe shook'took      | Which one        | Ketuk            |
| Wanted            | Pe gow'tin         | Which one        | Ke'aho           |
| Warbler           | E rit kan'e zuk    | Which way        | Nut'mon          |
| Warbler           | (to pin row'lik    | Whip             | Paw hah'ta       |
| Warm              | (to nok'to         | Whip             | Ke ke ah'hi ta   |
| Warrior           | (ing a ya'kite     | Whisky           | Tong'ong         |
| Wart              | (ot'mok            | Whisky           | Im'uk shred'na   |
| Was               | In al'o            | Whisper          | Iah u ba nuk'tuk |
| Wash              | Ir a vik'to        | Whistle          | Oo in yo ok'te   |
| Wash basin        | Moo so an'a        | Whistle (tin)    | Kal loak'ta      |
| Water             | Im'uk              | White            | Ka tek'to ak     |
| Waterfall         | Kre-to-im'uk       | White fish       | Too'poop         |
| Waterfall, slight | Shok a wok'to      | Whittle          | Chow wel'a roy   |
| Waterfall, medium | Man ik'to          | Who              | Kin'ya           |
| Waterfall, grand  | Shok a wah ik'took | Wick             | K pir'ak         |
| Water, none       | Im a'cho           | Wide             | Nu le'eat        |
| Wave              | Ow lit'ga          | Widgeon          | Kru'kuk          |
| Waves             | Im uk tok'took     | Widgeon          | U'wok            |
| Way               | Al'o               | Widgeon          | To'yok           |
| We                | Oo wung'a loo      | Wife             | Nu le'a          |
| Weak              | Te ya'cho          | Wife             | Koo ne'a         |
| Weak              | Te cha'cho         | Wife, my         | Ok a ru'ra       |
| Weather           | Neek'ya            | Wife, my         | Kawk             |
| We are going      | Ah yung ne ok'to   | Wiflow           | Chu'ret          |
| Weave             | Loo loo'uk         | Will             | Ke'ko            |
| Wedge             | Kah koo'na         | Win              | Tek she'ro       |
| Well              | An e'vah           | Win              | Goo ro lok'tu il |
| Well              | Ne rah ak'puk      | Wind (to ball)   | Im u'ga          |
| Went              | Ah uke'to          | Wind             | An o'wa          |
| Were              | Shum'na            | Wind, east       | Ke lung'a        |
| West              | Ka'tek             | Wind, north      | Ne gr'a          |
| West              | Nik'ik             | Wind, north      | Ne'yak           |
| Wet               | I lok'to           | Wind, south      | Oom'ga luh       |
| Wet soil          | Mok'uk noon'a      | Wind, south      | (to mud'ink      |
| Whale             | (ik'a wuk          | Wind, west       | Kik'ek           |
| Whale, large      | Oo ching no'ak     | Wind, west       | Kong ung'nung    |
| Whale, small      | In u'to            | Window           | E go lah'to      |
| Whale, small of   | Pub'o greet        | Windpipe         | Teopt u          |
| Whale back        | Tim ung'a          | Wing             | E Shok ku'a      |
| Whale belly       | Shag'a             | Wing             | E chu'ka         |
| Whale ear         | Oo gung'a          | Wint-r           | Oo ho'puk        |
| Whale eye         | E ring'a           | Winter           | Oo ke'ek         |



|                 |                     |                |                 |
|-----------------|---------------------|----------------|-----------------|
| Winter darkness | Kop lo'tok          | Wrist          | Ty a no'ka      |
| Winter darkness | Shi kin'ye luk      | Writing        | Og luk'to       |
| Wipe            | Pe'yok              | Writing        | Min u ok tok'to |
| Wire            | (ha'wik al o'ta     | Yawn           | Ow chew'to      |
| Wish bone       | Mit ko'a            | Year           | Oo ko'ok        |
| Wish bone       | Pe'tu mak           | Year (next)    | I pah'go        |
| Wolf            | A moh'oak           | Yellow         | E chook'to ak   |
| Wolf            | A mow'o             | Yes            | Ong ek'to       |
| Wolk, dark      | E guh'a lik         | Yesterday      | Oo noo'men      |
| Wolverine       | Kap'wa              | Yesterday      | Ik pug rah'pak  |
| Woman           | Ok an'ok            | You            | Il'we           |
| Woman           | Ok an'to            | You (familiar) | Oo'ma           |
| Wound           | Ke ru'it            | You are        | E lip'cho       |
| Wound           | Ke ru'ok            | You have       | Il im'ne        |
| Wood climber    | Ke ru'mik           | You will       | E lip'tin       |
| Wood, drift     | Tak ig erie-ke'ruok | Young boys     | Nu gat po gi lo |
| Work            | Na vak'to           | Young girl     | Nu go uk'mak    |
| Worm            | Too let'chuk        | Young girl     | Nu go uk saw're |
| Wound           | E ke'na             | Young man      | Nu gat pe'a     |
| Wreath          | Ke pit ching'a ru'a | Young men      | Nu gat pe ah're |
| Wring           | Kit look            | Yours          | E lip'cho       |
| Wrinkle         | E mon ik'ten        |                |                 |

ESKIMO-ENGLISH VOCABULARY.

|                  |                       |                     |                          |
|------------------|-----------------------|---------------------|--------------------------|
| Ab'a bah         | Talk                  | Ah'lik              | Thong                    |
| Ab a lauha'ta    | Fish-pole             | Ah lok'egy          | Are they gone            |
| Ab'a rok         | Summer festival       | Ah lok she na'luk   | Will not go              |
| Ab a rotal'ik    | 'Ub bear              | Ah lok'to           | Gone                     |
| Ab'ayok          | Musael                | Ah'me               | Skin                     |
| Ag a ah'tua      | File                  | Ah me'a             | Scab                     |
| A'go             | Of                    | Ah me'chuke         | Rim                      |
| A go'e'tite      | Of them               | Ah mik cho'a        | Fine glover's needle     |
| Ah'a lage        | Whale killer          | Ah min cok'te goot  | Put on canoe-cover       |
| Ah'a rouk        | Loon                  | Ah min o'it         | Ready                    |
| Ah'a yate        | Limb                  | Ah moo'tin          | Keep time                |
| Ah'che           | Get                   | Ah ne ah'poon       | Snow on ground           |
| Ahehe'a          | Berries               | Ah nu na che ak     | Genial                   |
| Ah chrat'chy     | A plant               | Ah nung ne ah'te go | Going home               |
| Ah chuk'to       | Land                  | Ah on'yok           | Old squaw duck           |
| Ah chok'tun      | Land                  | Ah ook chook'to ak  | Raw                      |
| Ah drab'ne       | Ancient               | Ah'pah              | Father                   |
| Ah g'h'oh        | Grindstone, whetstone | Ah pah'lu           | Don't                    |
| Ah gung'a ro a   | Stubborn              | Ah'pl               | Distant                  |
| Ah hol'ik        | Old squaw duck        | Ah re'gay           | Beautiful                |
| Ah ik'chu        | Rub                   | Ah re'gay'luk       | Starfish, clubs in cards |
| Ah'ka            | Mother                | Ah re'gy            | Glove, hand              |
| Ah kah'ga        | Mother                | Ah rok'to           | Kick                     |
| Ah kal'luuk      | Fish                  | Ah'te ga            | Take from                |
| Ah kal'lu        | Fishes                | Ah te-mes're gook   | Even                     |
| Ah kalook'pe     | Little brother        | Ah tik'a lo ne      | Steeking                 |
| Ah kaloo'ruk     | Salmon                | Ah'tok              | Small owl                |
| Ah ke a          | Buy                   | Ah tuk'kwai         | Sound                    |
| Ah keche'na      | Relative              | Ah tuk tow'ra       | Musical instrument       |
| Ah ke'chuk       | Buy, trade, sell      | Ah tut'a            | Listen                   |
| Ah ki chung      | Whale's tail          | Ah uke'to           | Went                     |
| Ah kim nok'toak  | Full of life          | Ah upe'kot          | Box                      |
| Ah'kin           | Pillow                | Ah vu ga'wah        | Divide                   |
| Ah ko a          | Stern of a boat       | Ah van a pum'a      | From now                 |
| Ah kuh a le grok | Black tanned leather  | Ah vung'a           | Take from                |
| Ah koh'go        | In the morning        | Ah wan'e            | From                     |
| Ah koh'puk       | This morning          | Ah wik to'ak        | Departed                 |
| Ah'kok           | Bitter                | Ah wuk tok'puk      | A poke                   |
| Ah kwey'tuk      | Short cloak           | Ah wun'mute         | Chum                     |
| Ah kwok'a look   | Sleigh bell           | Ah'ya               | Staff                    |
| Ah kwok a lung'a | Dinner bell           | Ah yeh'ok           | File                     |
| Ah kwok a lu ok  | Ship's bell           | Ah yo'a             | Cancer                   |
| Ah'koon          | Paddle                | Ah yok'te           | Go                       |
| Ah kou'ta        | Batter                | Ah yo'ok            | Mushroom                 |
| Ah ko'ta         | Rudder                | Ah yung'ne ak to    | We are going             |
| Ah'kun           | Stop                  | Ah shu'ak           | Bruise                   |
| Ah kun'alo       | To the right          | Ah zre'ga           | Let                      |
| Ah kupta         | Stir                  | Ah sre'ruk          | Warm                     |
| Ah'kut           | A plant               | Ah ka ruk           | Medium box               |
| Ah kus'rait      | Canvas back duck      | Ah ke le'ga         | Baroy                    |
| Ah kwok'a        | Knot in a tree        | A'koo po'ta         | Chair                    |
| Ah lang neak'to  | We are going          | A'keep to tot'in    | Long boots               |

|                        |                       |                       |                              |
|------------------------|-----------------------|-----------------------|------------------------------|
| A koo'pik'ta           | Long deer boots       | An ok'ta              | House fly                    |
| A koo'puk              | Evening               | An o'ka               | Air                          |
| A koo'puk a loo'ra     | Sat                   | An o'ke'luke          | Ship's block                 |
| Al'a pah               | Cold                  | An e lo rok'to        | Kill                         |
| Al'a pah took          | Very cold             | An'oot                | Dog harness                  |
| Al'a pah yak'took      | Intense cold          | An'ootit              | Paddle                       |
| Al'e ga'ret            | Small oongarook seal  | An o'wa               | Wind                         |
| Al'e ga'the ta         | Border                | An o'wa kah           | Gale                         |
| Al'ego                 | Mica                  | An ow ok'loun         | Axe                          |
| Al'eh                  | Ripped                | An ow ti'uk           | Hotchkiss rifle              |
| Al'ep'e ta             | Back and forth        | An ow tok'puk         | Kind of bird                 |
| Al'gest cho            | Could not             | An ow to la too'tek   | Hotchkiss bullet             |
| Al'gung                | Birth                 |                       | moulds                       |
| A leh tah              | Tear, tattered        | An uk'cho             | Undo                         |
| A lik'to               | Full of holes         | An uk'ta              | Visit                        |
| Al lay chook'tounga    | Play                  | An uk ta pak'too      | High                         |
| Al'e gro               | Feldspar              | An uk ter va'uk       | Breathe                      |
| Al'lo ke gy            | Have they gone        | An uk tok'to          | I will go, too               |
| Al'look to a           | Lick                  | A nung ne rah         | Whale's spout                |
| Al'loo'ra              | Soup                  | Ap'kna                | Road                         |
| Al'lu'e hut            | Dock weed             | Ap'kwot'e             | Head                         |
| Al'lupe to ak          | Ice cream             | A'poon                | Frost, or snow               |
| Al'lu reuk chum'na     | Put on coal           | Ap'wouk to            | Piece                        |
| Al'lu tok              | Spoon                 | A'r'rah               | Arche, hurt                  |
| Al'o                   | Crooked               | A se'ret              | Berries                      |
| Ak'a                   | Coal                  | A shu'na              | What                         |
| Al'ok'egah             | Wet                   | A shu'rok             | Bad                          |
| Al'ok'le on            | Door-mat              | A shu pi'ak'to        | Very bad                     |
| Al'on yok              | Horizon               | An ke me'tuk          | Finger ring                  |
| A loot koo che ne      | Alone                 | At'a                  | Deaf, quit                   |
| Al'ora                 | Bent                  | At'a go               | Notice                       |
| Al'o tok               | Spoon                 | At ak'm e             | Weak                         |
| A lo ta                | Violin                | At a sheet'she        | Get out                      |
| A mag'srok'to          | Sew                   | At cha kin'ga         | Who is he                    |
| Am a hituk             | Plenty                | At chu                | I don't know                 |
| Am a lok tak           | Much plenty           | A tig'a               | Cloak, coat, shirt           |
| Am a ok tu a           | Few                   | At il'a go            | Put on cloak                 |
| Am fi'ga               | Joint                 | At lik'a chaw         | Span                         |
| Am to a'at'it          | In succession         | A tow'shek            | One                          |
| A'oot'ook              | Wolf                  | A tow she me          | One of them                  |
| A'oot'it               | Humpback salmon       | At tan'e              | Beyond, after                |
| Am of'kwu              | Front                 | At tik'a lone ig'alou | Pair of stockings            |
| A'noo tok to ak        | Boa for frothing      | At ti'loo             | Grandmother                  |
| A'noo'lik              | Snow bird             | At toad lok           | Stocking                     |
| A'noo'gost             | Eider-duck            | At to'a lu            | Song                         |
| A'noo'lok              | Eider duck            | At to'lo              | Sing                         |
| A'noo'o                | Wolf                  | At took'to a          | Lend                         |
| An                     | off                   | At tun'e wit'o        | Out of reach                 |
| An'at'ah               | Sick                  | At tung'a             | Male                         |
| An'a tok'to            | Heelshe               | At tu'a               | Backbone                     |
| An'a'wa                | Brown duck            | A tuk a tong'ner uk   | Musical instrument           |
| An'a'at'at'at'at'      | Remaining             | An'leok'puk           | Tomcod                       |
| An'a'uk                | Well                  | A ve'uk               | Muscle                       |
| An'a'uk a'at'at'at'at' | Fort                  | A vwo                 | Root, substitute for tobacco |
| An'g'ou                | Companion             |                       |                              |
| An'ing                 | Leave                 | A wad'uk              | Father-in-law                |
| An'ing a'at'at'        | We are leaving        | A what tal'e gow'to   | Snow bird                    |
| An'ing'ou              | Old narwhal           | A win yate            | Lemming                      |
| An'ing'ou              | Old narwhal           | A wuk to chah'tin     | You will send                |
| An'ing'ou to           | Not coming            | A yom'ah              | Noise                        |
| An'ing'ou              | Fast                  | A yoon                | Male                         |
| An'ing'ou              | Snow house            | A yoon sell'a         | Master                       |
| An'ing'ou tok          | Choking               | A'z'goun              | Ice scratcher                |
| An'ing'ou tok'tounga   | Wish to go to a house | A'z'goun'a            | Let it be                    |
| An'ing'ou tok          | Chisel                | A'z'uk to             | Pole                         |
| An'ok'uk               | House fly             | Belaphar              | Tent                         |

|                      |                                         |                      |                                  |
|----------------------|-----------------------------------------|----------------------|----------------------------------|
| Bonelek'to           | Leader                                  | Chuk loo'ok          | Cache                            |
| Chah ah lin'a tuk    | Butterfly                               | Chun o rek'to        | Heavy cloak                      |
| Chah ok'tuk          | Read                                    | Chung'ho             | Dorsal fin                       |
| Chah'a ana           | Breast of deer                          | Chung ne ug'gah      | Chest                            |
| Chal a otat          | Wolf and wolverine<br>trimmings blended | Chung na yek'to      | Jealous                          |
| Chal'e gah           | Scissor cut                             | Chung mug'gah        | Breast                           |
| Chal'ek'che          | Scissors                                | Chun uk too roo'ok   | Harlot                           |
| Chal'nok             | Bone                                    | Chu'et               | Willow                           |
| Chal nok'cho         | Take out bone                           | Chu'u                | Tea                              |
| Chalupet'ook         | Morsel                                  | Chu uke chu ah'chu a | Scratch                          |
| Cham'e rah           | Apron                                   | Chu'wa               | Roe                              |
| Chan'ik              | Deer hair                               | Chy                  | Tea                              |
| Cha nok              | Pipe                                    | Chy'elke             | Cache                            |
| Chap poote           | Bird's nest                             | Chy young a to a     | Empty-headed fool                |
| Chate ko'a           | Knee                                    | Dak to'a             | Kidney                           |
| Chate kong'a roa     | Kneel                                   | Do'bra               | Sufficient                       |
| Chavo'a              | Divorced                                | Eag a we'e kin       | Pocket                           |
| Chav'ok              | Divorced                                | Eag ru'ga            | Testicles                        |
| Cha vow'te           | Tools                                   | Eat'pik              | Small dock weed                  |
| Chawik'a lo ra       | Wire                                    | E boo ro'ak          | Earthquake                       |
| Chawil a ro me       | Whistle                                 | E boo ro'ak          | Ice pressure                     |
| Chawilik             | 44 Winchester rifle                     | E'che                | Smoke                            |
| Chawilik puk         | 45 Winchester rifle                     | E che a              | Chimney                          |
| Chawil'ok            | Brass                                   | E cheh'a wik         | Hood fringe                      |
| Chawing'mon          | Iron                                    | E cheh'in            | Enter                            |
| Chaw'ne              | Rainbow                                 | E che mal'o          | Think, believe                   |
| Ché bo a             | Bottom of sole                          | E che mal'o too      | Sad                              |
| Ché cha'ru           | Side                                    | E chig'a nok         | Adze or nephrite stone           |
| Ché gok a look to ak | Brattle                                 | E cho                | End                              |
| Ché h'a ak' luk      | Tired                                   | E cho'hin            | Wing                             |
| Ché h'a lo me        | Cache                                   | E chook              | End                              |
| Ché na'ya            | Pipe                                    | E chook to a         | Fade                             |
| Ché og u a           | Whale's head                            | E chook to ak        | Yellow                           |
| Ché'ra               | What now                                | E choop chu'look to  | Hiccough                         |
| Ché to ok'to a       | Toboggan                                | E chow'ta            | Adam's apple                     |
| Ché ung'a ra         | Pull                                    | E chuga              | Drink                            |
| Ché ve ah ga         | Hip                                     | E chug'e ra          | Seven                            |
| Ché vol'geet         | Large white stripe                      | E chu ka             | Wing                             |
| Ché zel'geet         | Small white stripe                      | E chuk'a leun a      | May I enter                      |
| Chik'a ro            | Wink                                    | E chuk'atik a go     | Come in                          |
| Chiu'o ra            | Bind                                    | E chuk'a rook        | Go out                           |
| Chit kwo             | Fipper                                  | E chuk'a tin         | Come in                          |
| Cho a me ma          | Scarf                                   | E chuk la ago        | I go in                          |
| Chok'pek             | Whale's tail                            | E chum'a             | Enter                            |
| Chou loo me a        | Bowstring                               | E chung'mek          | Parasite gail                    |
| Choop loo to         | Cumnaple                                | E chung ok olek      | Parasite gail                    |
| Chuplek to wat       | Dust                                    | E cher roa           | Stagnation of blood              |
| Chow'ro              | Cup                                     | E ek'tut             | Shut up                          |
| Chow we pe se lap    | Sharp                                   | E ek kik             | Hard, phable wood                |
| Chow we'rik          | Steel blade                             | E el a ok pe         | To swallow                       |
| Chow we tuk          | Knife cut                               | E el'at              | Hera                             |
| Chow'wik             | Iron-stick knife                        | E el kilak a rook    | Tanned                           |
| Chow'wik tuk         | Cut with knife                          | E gal                | Kitchen                          |
| Chu ba la ta         | Pipe cleaner                            | E gal to go to       | The cook                         |
| Chu bin'ok to        | Bioy breath                             | E gal ta to a        | The cook                         |
| Chu'cha              | Age                                     | E gal to             | Window                           |
| Chug'a ren           | Archer                                  | E gal toak tuk       | Moonshine                        |
| Chuk a muk a to a    | Barrel                                  | E gal'ook            | Enough                           |
| Chuk'loo             | Ally                                    | E gal'ook to         | Snowblind                        |
| Chuk loo le ro       | Soldier                                 | E galu               | Mate, or one of a pair           |
| Chuk loo ne'et n     | Yield to the                            | E gal ta shaga       | Tossing balls with both<br>hands |
| Chuk loo ne'cho      | Nothing                                 | E gal'ok cho         | Can not see out                  |
| Chuk loo ne'ne       | Count the                               | E galu ke cho'na     | Tossing balls with feet          |
| Chuk loo ru'ne       | Lo                                      | E ga me ga           | Noth case                        |
| Chuk loo ru'te       | You do                                  | E ga'nek             | Meteor                           |

|                  |                          |                      |                      |
|------------------|--------------------------|----------------------|----------------------|
| E ga roa         | Cooked done              | E lung'a             | Enough               |
| E ga sh          | Meteor                   | E men ik'ten         | Wrinkle              |
| E ga le kret     | Edge                     | E moogah             | Roll                 |
| E ga shik        | Black wolf               | E moogwah            | Coil, or roll up     |
| E go shi to      | Ashamed                  | E mun'e ak           | Sea shell            |
| E go w re        | Temple                   | En me roa            | Ostracise            |
| E hot            | Mountain                 | E nungne ak          | Alley dye            |
| E hok            | Shing                    | E op ke lup          | Sharp                |
| E hith           | Yea                      | E pe'a               | Cup handle           |
| E ka hok toong a | Lazy                     | E pe'goun            | Let go               |
| E ka in ga       | Mute                     | E pe tung a          | Fish-line            |
| E ka na roa      | Snouldering              | E pik chow la go     | Sharpen              |
| E ka shang a     | Sins                     | E pik chom           | Sharpenet            |
| E ka ro chok     | Suspenders               | E pik tah            | Dull                 |
| E ka roa         | Knot in a tree           | E pirak              | Wick                 |
| E ka rok         | Slap                     | E pr ak a ve a       | Flame                |
| E ka ru la       | Deer pen                 | E psu cho a          | Put a handle on      |
| E ka we          | Pocket                   | E psu'ta             | oar                  |
| E ka che ak      | Fearful                  | E pung'a             | Let go               |
| E ke che ro a    | Afraid                   | E rage               | Exclamation of fear  |
| E ke che ro a    | Ghost                    | E re gah             | Eye glasses          |
| E ka che tet     | Edge of shore ice        | E re ge me           | I saw                |
| E ke' gut        | Elevated cache           | E re gik             | Saw                  |
| E ke mealik      | Rumfire Winchester rifle | E re hato            | Opera glass          |
| E ke ro a        | Wound                    | E rek che ro a       | Screen over the dead |
| E ki ro a        | Mattress                 | E re luk cho ak      | Blizzard             |
| E ki'ka          | Guns                     | E renik              | Cave                 |
| E ka nune        | Towel                    | E re tok pe go       | Worn out             |
| E ko             | Snapet                   | E re to muk          | Waterfall            |
| E ko che a       | Elbow                    | E re to vank         | Plover               |
| E ko che gah     | Elbow                    | E rik a gah          | Goggles              |
| E ko chok to in  | You rape                 | E ring ru tok        | Dizzy                |
| E ko ch          | Plane                    | E rit                | Eye                  |
| E ko ch a        | Matches                  | E rit ka ne ruk      | Warbler              |
| E ko chet        | Matches                  | E rit kest ke        | Lesser               |
| E ko chet a      | Match box                | E rit shik a moe tok | Eyes shut            |
| E ko k chom a    | Elabor                   | E ro kok tra         | Lake down            |
| E ka ng a ro a   | Poverty stricken         | E rok se lung a      | Leut up              |
| E ka nne         | West                     | E rok se lu tu       | Ye out up            |
| E ka chok a      | Black tanned leather     | E roo vook           | Piling up            |
| E ka chok a      | Bontre                   | E se voo wuk         | Gun-spring           |
| E ka ch a        | Foot                     | E shane              | To them              |
| E ka ch a        | Itu                      | E shes out look      | Gun caps             |
| E ka ch a        | Ho shent                 | E shok ku a          | Wing                 |
| E ka ch a to     | Wound the                | E sho wak            | Bandied seal         |
| E ka ch a to     | Poverty                  | E shu a wak          | corner               |
| E ka ch a to     | Chok                     | E shuk               | Leather string       |
| E ka ch a        | Sing                     | E take               | Open                 |
| E ka ch a        | Shing                    | E to gah             | Foot                 |
| E ka ch a        | Shing                    | E to gah             | Hearts of cards      |
| E ka ch a        | Shing                    | E to gah             | Leut door            |
| E ka ch a        | Shing                    | E to gah             | Depth                |
| E ka ch a        | Shing                    | E to gah             | Deep                 |
| E ka ch a        | Shing                    | E to gah             | Little finger        |
| E ka ch a        | Shing                    | E to gah             | On                   |
| E ka ch a        | Shing                    | E to gah             | Snap off             |
| E ka ch a        | Shing                    | E to gah             | Wake up              |
| E ka ch a        | Shing                    | E to gah             | Plane                |
| E ka ch a        | Shing                    | E to gah             | Gun out              |
| E ka ch a        | Shing                    | E to gah             | Shavings             |
| E ka ch a        | Shing                    | E to gah             | Clam                 |
| E ka ch a        | Shing                    | E to gah             | Setting hen          |
| E ka ch a        | Shing                    | E to gah             | Water                |
| E ka ch a        | Shing                    | E to gah             | Medicine rifle       |
| E ka ch a        | Shing                    | E to gah             | Thread or snow       |
| E ka ch a        | Shing                    | E to gah             | Downy                |

|                            |                       |                              |                            |
|----------------------------|-----------------------|------------------------------|----------------------------|
| <b>E ve weet</b>           | Kind of grass         | <b>I'p' hun</b>              | All                        |
| <b>E yarok</b>             | Black bear            | <b>Ii u hut'in</b>           | All, everything            |
| <b>E ying'ye ok</b>        | Wish to eat           | <b>Ii u pah ung a</b>        | Lining                     |
| <b>E zre gok'to a</b>      | Chased                | <b>I'p' park</b>             | Undershirt                 |
| <b>E zre gown</b>          | Marline spike         | <b>Ii up nah'tah</b>         | All                        |
| <b>E zre ko'ak</b>         | Frost bitten          | <b>I'p' von</b>              | Pill                       |
| <b>Foch i'young or</b>     | Baby dear             | <b>Ii u weet</b>             | You                        |
| <b>Gou re lok'too it</b>   | Win                   | <b>Ii u weet so a</b>        | Do you understand          |
| <b>Hah</b>                 | Yes                   | <b>Ii yo ne</b>              | Inside                     |
| <b>Hah ne'ta</b>           | Scared                | <b>Iuca cho</b>              | No water, empty            |
| <b>Hi</b>                  | What (exclamation)    | <b>Im ah'ok</b>              | Peninsula                  |
| <b>Hing i</b>              | Pelvis                | <b>Im a ik to ak</b>         | Pearl                      |
| <b>Hi pah</b>              | Pew                   | <b>Im a kok</b>              | Soup                       |
| <b>Hi pah'go</b>           | Recent past           | <b>Im an e</b>               | Shell-fish                 |
| <b>Hi pah'in</b>           | In the past           | <b>Im ate kon</b>            | Pass                       |
| <b>Hi pung a</b>           | Mate or second person | <b>Im a'yo</b>               | towel                      |
| <b>Hi up' kaw tuk</b>      | Small box             | <b>Im na chok'to a</b>       | Travail                    |
| <b>Hi up' kot</b>          | Large box             | <b>Im ne a</b>               | Will you                   |
| <b>Hi low</b>              | Unborn seal           | <b>Im o'ga</b>               | Dipper                     |
| <b>I bu ra</b>             | Thick                 | <b>Im o ro</b>               | Pipe of tobacco            |
| <b>I cho to e'guy</b>      | Shall I give          | <b>Im p na ak</b>            | Mountain sheep             |
| <b>I che ne</b>            | Cave me               | <b>Im p ni</b>               | Cliff                      |
| <b>I ga lok</b>            | Laugh                 | <b>Im p not</b>              | Cliff                      |
| <b>I ga lok to</b>         | Lau'ling              | <b>Im u ga</b>               | To wind or ball            |
| <b>I ga lu</b>             | House                 | <b>Im u ga lik tik to ak</b> | Full moon                  |
| <b>I ga lu'puk</b>         | Trader's house        | <b>Im u gow ro</b>           | Cup                        |
| <b>I ga lute</b>           | Town                  | <b>Im u greh</b>             | Cup                        |
| <b>I ga to ro a</b>        | Giggle                | <b>Im uk</b>                 | Water                      |
| <b>I ga le a</b>           | Shrimp                | <b>Im uk a zrook</b>         | Bay or harbor              |
| <b>I ga pe ro</b>          | Revolver              | <b>Im uk sted na</b>         | Whisky                     |
| <b>I ga up' chai' chok</b> | Smile                 | <b>Im uk tok to ak</b>       | Waves                      |
| <b>I ga lu pa</b>          | One smile             | <b>Im uk too</b>             | Drink                      |
| <b>I ga neek</b>           | Shrimp                | <b>Im uk'tua</b>             | Bathe                      |
| <b>I ka yuk to</b>         | Side way              | <b>Im u lu ra</b>            | Jointa                     |
| <b>I ka kate chu tu a</b>  | Lazy                  | <b>Im u tu</b>               | Stain                      |
| <b>I ka kik</b>            | Nat                   | <b>Im u na</b>               | Ja mine                    |
| <b>I ka na wak</b>         | Brown owl             | <b>Im u auk tung a</b>       | I am drunk                 |
| <b>I ka na sa hey i</b>    | Brown owl             | <b>Im u op kwo tah</b>       | Bridge                     |
| <b>I ka ne a</b>           | Fire                  | <b>Im a le</b>               | It                         |
| <b>I ka ne a to</b>        | Night                 | <b>Im ak to</b>              | Go back                    |
| <b>I ka ne grum ak</b>     | Primer                | <b>Im eek'te nech</b>        | Sit down                   |
| <b>I ka nek</b>            | Lightning or pyrite   | <b>Im eha wik</b>            | Guillemot (winter plumage) |
| <b>I ka nek a tik'at</b>   | Primer                | <b>Im en</b>                 | Apartment                  |
| <b>I ka nek a wak</b>      | Stove or fire place   | <b>Im ek tu</b>              | Ate you through            |
| <b>I ka nek u tu'ka</b>    | Net or stone ship     | <b>Im en me</b>              | Toggle                     |
| <b>I ka ne la gow'ak</b>   | Stove lamp            | <b>Im ep koh ok</b>          | Mirage                     |
| <b>I ka ne shok a'rook</b> | Lighting              | <b>Im ok to</b>              | Lie down                   |
| <b>I ka ne shog a'rook</b> | Lighting              | <b>Im u ba ook took</b>      | A crowd                    |
| <b>I ka pa'kak</b>         | Goat fat              | <b>Im u ke</b>               | Man                        |
| <b>I ka pa'kra'at</b>      | Sewer                 | <b>Im u ne up kwo tah</b>    | Spots on moon              |
| <b>I ka pe'ro</b>          | Sewing box            | <b>Im u ne wok</b>           | Doll                       |
| <b>I ka pe kra'h pak</b>   | New past              | <b>Im u pe'a</b>             | Strangers                  |
| <b>I ka pug rah'pe</b>     | Yesterday             | <b>Im a took</b>             | Little                     |
| <b>I ka pug rak</b>        | Yesterday             | <b>Im u yok ut ting a</b>    | Dwarf                      |
| <b>He'che' mo tu a</b>     | Reverend              | <b>Im weet</b>               | Native met.                |
| <b>He'ah pak</b>           | Reverend person       | <b>Im yo</b>                 | Cut                        |
| <b>He'ak'ch'ak</b>         | Reverend person       | <b>Im yok</b>                | Beetle                     |
| <b>He'ah'rook</b>          | Reverend person       | <b>Im yo'toke</b>            | Live                       |
| <b>He'gok'ch'ak'ch'ak</b>  | Swelling              | <b>Im'yuk</b>                | Bug                        |
| <b>He'gow'e</b>            | Extra                 | <b>I pah'go</b>              | Next year                  |
| <b>He'ik a</b>             | Knee                  | <b>Ip kuh'na luk</b>         | Turbot                     |
| <b>He'le'gah</b>           | Child                 | <b>Ip kel'nek'to</b>         | Turbot                     |
| <b>He'le'yang'ak</b>       | Boys                  | <b>Ip koon'ek'cho</b>        | Serape                     |
| <b>He'lu ne</b>            | You have              | <b>Ip pe'ah to</b>           | Jelly fish                 |
| <b>I lok to</b>            | Wet                   | <b>I ra'wik a a'ti'a go</b>  | Wash clothes               |
| <b>Im' a lok</b>           | Undt                  |                              |                            |

|                      |                                   |                  |                      |
|----------------------|-----------------------------------|------------------|----------------------|
| Pro                  | Bring                             | Ka o'te          | Call                 |
| Ir up kah ah         | Drop                              | Kap a lang'a     | Stab one's self      |
| Ir up kwok to        | Dropped                           | Kape gah         | Servant              |
| Ir up kwok t t       | Cavern                            | Kape gah         | Snow-drift           |
| Ir za rup ka         | Carry                             | Kape guan        | Lever                |
| I-ha a               | Sleeve                            | Kap out'uk       | Foam                 |
| Ish'ik'oot           | Deer boots                        | Kap out'uk       | Awl                  |
| Ish'u ba huk tak     | Whisper                           | Kap seet         | How much             |
| It                   | Vine                              | Kap se tak       | Sugar                |
| It ki ah ro          | Dance of death or ex-<br>haustion | Kap sin'ik       | How many             |
| It koox took         | Let me have the things            | Kap we           | Wolverine            |
| I took               | Give                              | Kap we to ak     | Marten               |
| I yuh uk             | Snipe                             | Ka ra o          | Cry                  |
| I wok                | Waltzes                           | Ka tek cho       | Red                  |
| Ka a tig a           | Shoulder blade                    | Ka rek pul'uk to | Blush                |
| Ka cheng to uk to ak | Winter festival                   | Ka rek to ak     | Red                  |
| Ka n took            | Cry                               | Ka ret kok       | Took under           |
| Kah loont            | Gum caps                          | Ka too luk       | Gun hammer           |
| Kah cha              | Hungry                            | Ka to x          | Cards                |
| Kah ek'ok            | Braids                            | Kat cha          | Arm                  |
| Kah kak took         | Called in                         | Kat che          | Side                 |
| Kah ko rah ah        | Call                              | Kat che gat'ok   | Harbor seal          |
| Kah no ne            | In the                            | Kat chug'a       | Exhort               |
| Kah ok'uk too it     | Beach                             | Ka te            | Chalk, or white rock |
| kah to a             | Hungry                            | Ka tek           | West                 |
| Kah tuk              | Wet as meat                       | Ka tek a tik     | Middle finger        |
| Kah ya a             | Sand or gravel                    | Ka to rah        | Waist                |
| Kah ya a             | Out or up there                   | Ka took kook     | Quack of a loon      |
| Kat was              | Bad                               | Kat puga         | Hip                  |
| Kat was              | Plains, salt                      | Ka tuk a lum a   | Finger ring          |
| Ka to g to a         | Bile                              | Ka tuk to it     | White                |
| Ka p seet            | Street                            | Ka vug a to a    | Skinning knife       |
| Ka k'ok'ok           | Teard                             | Ka wuk su ruk    | Brown                |
| Ka k'ok'it           | Teard                             | Ka wuk           | My wife              |
| Ka la gow to         | Cup                               | Ka wuk           | Dark weed            |
| Ka la                | Sand paper                        | Ka wu we it      | Pocket               |
| Ka ra o              | Sa                                | Ka wuk           | Do it                |
| Ka ren'ok            | Spring water                      | Ka wu a          | Lamenting            |
| Ka ra                | Leaf                              | Ka wuk           | Plant                |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | To harden            |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | Capeze hawk          |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | Blue fox             |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | Round                |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | Stove lid lifter     |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | Capeze sled          |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | Go ahead             |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | Nail                 |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | Blot                 |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | A bolt               |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | Sky                  |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | Quick                |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | Quickly              |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | Home ball missile    |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | Lance                |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | Stairway             |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | Fresh                |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | Aurora               |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | Aurora               |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | Mastodon             |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | Mastodon ivory       |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | Venerable            |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | Aurora               |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | Swan                 |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | Sinking in           |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | Brindle mouse        |
| Ka ra a g a          | Leaf                              | Ka wuk to me to  | Hurry with it        |

|                            |                            |                           |                                |
|----------------------------|----------------------------|---------------------------|--------------------------------|
| <b>Ke'loo</b>              | <b>Inferior</b>            | <b>Kil la yung'a ro a</b> | <b>Sew</b>                     |
| <b>Ke loo'chuk</b>         | <b>Key, or bolt</b>        | <b>Kil'le</b>             | <b>Giant</b>                   |
| <b>Kel ooh'ru it</b>       | <b>Thunder</b>             | <b>Kil le yuk'a ruk</b>   | <b>Big and fat</b>             |
| <b>Kel'rot</b>             | <b>Sled</b>                | <b>Kil hile ruk</b>       | <b>King (cards)</b>            |
| <b>Ke lung'a</b>           | <b>East wind</b>           | <b>Kil low'tit</b>        | <b>Shuttle</b>                 |
| <b>Ke me le'ta</b>         | <b>Kiss</b>                | <b>Kil'ow</b>             | <b>Violin</b>                  |
| <b>Ke moo'good</b>         | <b>Pup</b>                 | <b>Kil'own</b>            | <b>Doctor's drum</b>           |
| <b>Ke mook'to</b>          | <b>Last-quarter moon</b>   | <b>Kil'own</b>            | <b>Measure of mesh in nets</b> |
| <b>Ke mug'init</b>         | <b>A plant</b>             | <b>Kil'reh</b>            | <b>Marmot hawk</b>             |
| <b>Ke na le'chuk</b>       | <b>Sheath</b>              | <b>Kil'ruk</b>            | <b>Marmot hawk</b>             |
| <b>Ke'nowk</b>             | <b>Face or mask</b>        | <b>Kil'ruk</b>            | <b>Roof, clear sky</b>         |
| <b>Ke now'na</b>           | <b>What name</b>           | <b>Kil'ruk</b>            | <b>Breakers</b>                |
| <b>Ke nung'a roa</b>       | <b>Crazy</b>               | <b>Kil'ruk</b>            | <b>Seven-year itch, sores</b>  |
| <b>Ke nung ok'to</b>       | <b>Foolish</b>             | <b>Kil'ye</b>             | <b>Tease</b>                   |
| <b>Ken yah roon</b>        | <b>Pepper or spices</b>    | <b>Kil'yo'ro</b>          | <b>Doctoring</b>               |
| <b>Ke pe'ak</b>            | <b>Score (twenty)</b>      | <b>Kil'yo'rok'to a</b>    | <b>Boat-hoel</b>               |
| <b>Ke peot'kege</b>        | <b>Count</b>               | <b>Kim me'a</b>           | <b>Eyelid</b>                  |
| <b>Ke pek'tol ago</b>      | <b>Sharpen</b>             | <b>Kim me'g'etel</b>      | <b>Constellation of stars</b>  |
| <b>Ke pig're tah</b>       | <b>Shroud-lashings</b>     | <b>Kim uh</b>             | <b>Coming home or back</b>     |
| <b>Ke pil a gong a</b>     | <b>Notching</b>            | <b>Kim ak'to</b>          | <b>Not coming</b>              |
| <b>Ke pit ching a ro</b>   | <b>Wreath</b>              | <b>Kim cho</b>            | <b>Turn forward</b>            |
| <b>Kep luk'to</b>          | <b>Bright</b>              | <b>Kim shuh'tin</b>       | <b>Weather</b>                 |
| <b>Ke rek</b>              | <b>To flute boot soles</b> | <b>King a</b>             | <b>Boat upper</b>              |
| <b>Ke rek nuk'to</b>       | <b>Black fox</b>           | <b>King a</b>             | <b>Shin</b>                    |
| <b>Ke ret'ta</b>           | <b>Frost-bite</b>          | <b>King ah zook</b>       | <b>Large elder-duck</b>        |
| <b>Ke ret'te ah</b>        | <b>Frost-bite</b>          | <b>King'a lik</b>         | <b>Lobby</b>                   |
| <b>Ke rook</b>             | <b>Wood</b>                | <b>King'ik to ak</b>      | <b>Heel</b>                    |
| <b>Ke ru'a</b>             | <b>Gun stock</b>           | <b>King muk'a</b>         | <b>Bite</b>                    |
| <b>Ke ru'it</b>            | <b>Wood</b>                | <b>King muk'tet</b>       | <b>Vise</b>                    |
| <b>Ke ru mik</b>           | <b>Brushwood</b>           | <b>King'muh</b>           | <b>Air-hole</b>                |
| <b>Ke ru peak</b>          | <b>Fit</b>                 | <b>King'ok</b>            | <b>Nose</b>                    |
| <b>Ke sha'ne</b>           | <b>This side</b>           | <b>King'ok'a</b>          | <b>Porcupine</b>               |
| <b>Ke sh'e'me</b>          | <b>Only</b>                | <b>King'ok'aleok</b>      | <b>Shin</b>                    |
| <b>Ke sho</b>              | <b>Whirl one</b>           | <b>King'sha</b>           | <b>Stay</b>                    |
| <b>Ke shok</b>             | <b>Anchor</b>              | <b>King'ngah</b>          | <b>Spy-glass</b>               |
| <b>Ke shok'polawh</b>      | <b>Is anchored</b>         | <b>King'ngah to</b>       | <b>Magnifying-glass</b>        |
| <b>Ke shok luk</b>         | <b>Will anchor</b>         | <b>King'ngah</b>          | <b>See it</b>                  |
| <b>Ke took ka'cho'ik</b>   | <b>Stuff</b>               | <b>King'ngah</b>          | <b>Spy glass</b>               |
| <b>Ke toop to ak</b>       | <b>Soften</b>              | <b>King'ngah</b>          | <b>Who</b>                     |
| <b>Ke tuk</b>              | <b>Which</b>               | <b>King'ngah</b>          | <b>Want to see</b>             |
| <b>Ke uk'tou ra</b>        | <b>Fringes</b>             | <b>Kito</b>               | <b>Coming</b>                  |
| <b>Ke u ru'ak</b>          | <b>Cold chill</b>          | <b>Kitch'a</b>            | <b>Scratch</b>                 |
| <b>Ke ge ru'a</b>          | <b>Sink</b>                | <b>Kit'ko'ate kon</b>     | <b>Transparent</b>             |
| <b>Ke vung'nuk</b>         | <b>East wind</b>           | <b>Kit'le'ok</b>          | <b>Curtain</b>                 |
| <b>Ke wek kah</b>          | <b>Lift</b>                | <b>Kit'look</b>           | <b>Wring</b>                   |
| <b>Ke wil'u wit ket ka</b> | <b>Scrapings</b>           | <b>Kit'look</b>           | <b>Second toe</b>              |
| <b>Ke win me'gah'u</b>     | <b>Lift me</b>             | <b>Kit'look</b>           | <b>Thigh</b>                   |
| <b>Ke ya'ek</b>            | <b>Chisel</b>              | <b>Kit'look</b>           | <b>East</b>                    |
| <b>Kil'ah'took</b>         | <b>Capsize kayak</b>       | <b>Kit'look</b>           | <b>Turn</b>                    |
| <b>Kil'en rak</b>          | <b>Cross fox</b>           | <b>Kit'look</b>           | <b>Shin</b>                    |
| <b>Kil'en rak'toak</b>     | <b>Blue fox</b>            | <b>Kit'look</b>           | <b>Fall</b>                    |
| <b>Kiget'ik</b>            | <b>Vise</b>                | <b>Kit'look</b>           | <b>Sweat dance</b>             |
| <b>Kig'le</b>              | <b>Flint scraper</b>       | <b>Kit'look</b>           | <b>Butterfly</b>               |
| <b>Kig'le to ak</b>        | <b>Flint scraper</b>       | <b>Kit'look</b>           | <b>They are coming</b>         |
| <b>Kig'lik</b>             | <b>Purple</b>              | <b>Kit'look</b>           | <b>Sweat</b>                   |
| <b>Kig'look to ak</b>      | <b>Cranks person</b>       | <b>Kit'look</b>           | <b>To boil</b>                 |
| <b>Kig'me'ah'took</b>      | <b>Pup</b>                 | <b>Kit'look</b>           | <b>Twist</b>                   |
| <b>Kig'mok</b>             | <b>Dog</b>                 | <b>Kit'look</b>           | <b>Sewing</b>                  |
| <b>Kil'iva</b>             | <b>Cone</b>                | <b>Kit'look</b>           | <b>Claw hammer</b>             |
| <b>Kik'haug'gow ro</b>     | <b>Vise</b>                | <b>Kit'look</b>           | <b>Back</b>                    |
| <b>Kik'to'ate</b>          | <b>Mosquito</b>            | <b>Kit'look</b>           | <b>Winter darkness</b>         |
| <b>Kil'a'vok to</b>        | <b>Sew</b>                 | <b>Kit'look</b>           | <b>Ed</b>                      |
| <b>Kil'le'ang a</b>        | <b>The y are coming</b>    | <b>Kit'look</b>           | <b>Eyebrow sky gun caps</b>    |
| <b>Kil'le'nek</b>          | <b>Drift ivory</b>         | <b>Kit'look</b>           | <b>White man</b>               |
| <b>Kil'le'nik</b>          | <b>Cloudy</b>              | <b>Kit'look</b>           | <b>Crown</b>                   |
| <b>Kil'le'nik'to</b>       | <b>Sew</b>                 | <b>Kit'look</b>           |                                |



[illegible]

|                     |                                    |                    |                   |
|---------------------|------------------------------------|--------------------|-------------------|
| Koo pe ge'ke ga     | Strip                              | Kush'nik           | Elastic           |
| Koo pe ge'on        | Undress                            | Kut ko ne'e oto    | Valley            |
| Koop gal'upe        | Musk-rat                           | Kuz'rite           | Hammer            |
| Koo pak'tuk         | A charm                            | Kuz ru'tok         | Hammer            |
| Koo re'geet         | Hills                              | Kwawk              | Frozen            |
| Koo roo'ok          | Land duck                          | Kwik'mek           | Edible grass root |
| Koo row'nok         | Small, speckled fish               | Kwip'atok          | Twine             |
| Koosh'kok           | White fox                          | Kwi'ro             | Urnate            |
| Koot'chuk           | Pellet                             | Ky                 | Come              |
| Koo ve'ga           | Pour                               | Ky'ak              | Closed boat       |
| Koo ve'ro           | Spill                              | Ky'le              | Come              |
| Koo'vin             | Empty                              | Ky o kot'ik        | Rug               |
| Koo via             | Bullet mould                       | Ky roll'ik         | Handed seal       |
| Koo'vu a            | Nozzle                             | Ky u ka'ok         | Flour             |
| Koo'ruk             | Big river                          | Ky u'look          | Black skin fish   |
| Koo wuk'sruk        | Flint                              | Ky u'ta            | Small dipper      |
| Koo ya gou'ta       | Intercourse                        | Ky u'te gan        | Scoop out         |
| Koo ya ro'ak        | Congratulate                       | Ky ya yar'til leet | Scates            |
| Koo yel gou'che tin | Glad                               | Ky y'o             | Leaning           |
| Koo yook to         | Intercourse                        | Lah low tig'a ton  | Gun sight         |
| Ko'pah              | Half                               | La lu gik'puk      | Flower            |
| Ko pal'uk           | Myxine                             | Leet teh'uk        | A rule            |
| Ko pel'o che        | Crab                               | Lo'rek             | Reverse           |
| Kop'poon            | Spades (cards)                     | Lik lin now ro     | Black goose       |
| Kop zha'rook        | Ill tempered                       | Loo'loot           | Web               |
| Ko re'gah           | White fox                          | Loo loo'tuk        | Making web        |
| Kot'ka              | Bird's breast                      | Lu'bet             | Remember          |
| Kot'la pak          | Axe                                | Luk lu'ik          | Brant             |
| Kot'la pou'ruk      | Hatchet, boy's axe                 | Luk u ey ak a'rook | Goose             |
| Kot me yung'oit     | Bud                                | Ma gou'ruk         | Howl              |
| Kot tel'loo         | Bark of tree                       | Mah'cha            | A plant           |
| Kot tow'ro          | Bucket                             | Mah mung'in ya     | Gum on whalebone  |
| Kot tung a go       | Sorry                              | Ma hoz ru it       | Anointing         |
| Koo'va              | Pour                               | Ma ik'cho          | Vomit             |
| Koo va'yo           | Sho-bucket                         | Ma lik'pa le       | Start             |
| Ko va'yok           | Red sunset                         | Ma lik sek'to uk   | Start to run      |
| Ko wek to'ak        | Under                              | Mal o              | Two               |
| Kow'it              | Hammer                             | Mal o gow rum e    | Schooner          |
| Kow'ita             | Plug tobacco                       | Mal o kit lu it    | Double seam       |
| Kow loo'kon         | Lamp chimney                       | Ma loo gatuk       | Leaf              |
| Kow mow'ook         | Burning out                        | Mal o te gow ruk   | Schooner          |
| Kow mun'e           | Broken up                          | Mal o tok'klona    | Straight          |
| Kown'ah             | Leaf fat                           | Mal ro'nik         | Two of them       |
| Kow ung a           | Brow                               | Ma lu'ge uk        | Moth              |
| Kow woo te          | Hammer                             | Ma lu gl'a sek     | Bee               |
| Ko yau'o            | Thank you                          | Ma lu gwit'uk      | Flat shell        |
| Ko yan ot'tua       | Thank you                          | Man                | Here              |
| Ko re'geet          | Council house                      | Man'a              | Here              |
| Kuh koo'ra tuk      | Wedge                              | Man'ik             | Egg               |
| Kuh yow'tah         | Shoulder-strap                     | Man'ik'to          | Shallow           |
| Kuk hung'a q lu tin | To lie down                        | Man'neh            | Here              |
| Kul loo'ke ut       | Bunch of fish                      | Mant na            | Another           |
| Kum'a               | Boots                              | Mant nea go        | Another time      |
| Kum'a roa           | Courageous                         | Ma too'tet         | Close             |
| Kum'neh             | Boots and pantaloons com-<br>bined | Mat to gab         | Blindfold         |
| Kung'ea             | Aside                              | Maw na             | Pin feather       |
| Kun nes're ve       | To the left                        | Meal o             | Soap              |
| Kun'no              | What will you do                   | Me cho et'che rek  | Pale              |
| Kun nok'to'ak       | Heartburn                          | Me chuk to tin     | Up to then        |
| Kun sek'too         | Mel                                | Me chu             | Sack              |
| Kun u cho'ok too    | Ashamed                            | Me chuh            | Cask              |
| Kun u le'ruk        | Frown                              | Mesh'lik           | Flaming knife     |
| Kun u nare a        | Angry                              | Me big'a rok       | Gum-wad           |
| Kush el'ook         | Bark of a tree                     | Me look            | Breast            |
| Ka shag'na          | Outer shirt                        | Me lu kat'a        | Flower            |
|                     |                                    | Mon'ch             | Stab              |

## ESKIMO-ENGLISH VOCABULARY.

|                   |                     |                  |                              |
|-------------------|---------------------|------------------|------------------------------|
| Mur-uk            | Sun                 | Mum-uk to a      | Level                        |
| Me-shu-lak        | Sheet               | Mun-e            | Nowhere                      |
| Me-tik            | Eider duck          | Mun-ek-chuk      | Flute with a needle          |
| Met-to-a          | Cover               | Mung-e-chuk to   | To curve                     |
| Me-tuh            | Alight              | Mung-ok to       | Thick weather                |
| Me-ut             | Grindstone          | Mun'oit          | Turf                         |
| Mik-a             | Hoof                | Munt-na          | Thus, so, this               |
| Mik-a-ru-tu-ru    | Little              | Munt-ne-a-gu     | Later                        |
| Mik-a-ru-uk       | Third finger        | Mun'uk           | Fish pole                    |
| Mik-a-ru-uk       | Third toe           | Munuk-to-a       | Black                        |
| Mik-a-ru          | Little              | Muppo-wa-ga      | Gluttony                     |
| Mik-uk            | Flaming knife       | Mur-sho          | Fish gull                    |
| Mik-uk-to-a       | Grass               | Mush-o           | Wild parsnip                 |
| Mung-ru-muk       | Little              | Mut-koo-a        | Feather                      |
| Mun-ok-took       | String              | Mutteroo         | Other side                   |
| Mun-uk to         | Tarot               | Mu-y-tung-gu     | Ice-baller                   |
| Mun-ut            | Graphite            | Mu-ru            | There is, here is            |
| Mun-uk-tu-to      | Writing             | Muz-ra-ga-a      | It was                       |
| Mun-utok-to       | Jump                | Muz-ru-ke        | Here now                     |
| Mish-a-yuk to     | Bottle              | Muz-re-ko-gu     | Is more                      |
| Mit-pul           | Old bread           | Naak-a-mu        | Tea pot                      |
| Mit-ko-a          | Wish bone           | Na-goo-na        | Per-winkle                   |
| Mit-ko-a-to-ut    | Boots               | Na-gut-shung-not | Calf of leg                  |
| Mit-koon          | Animal hair, needle | Nah              | When                         |
| Mit-koon-uk       | Feather             | Nah-che-nuk      | Beggar                       |
| Mit-koon-a-chu-a  | Needle              | Nah-che-ne       | Wooden fork                  |
| Mit-koon-uk       | Iron                | Nah-gu           | No                           |
| Mit-to-ru         | Turn inside out     | Nah-kot-chu      | Bladder                      |
| Mun-tow-to        | Ladder              | Nah-luk-ate      | Pitch or tone                |
| Mun-lak-to        | Not up              | Nah-na           | When                         |
| Mun-te-ut         | Come up             | Nah-ne           | No                           |
| Mu-yo-ru          | Upon                | Nah-a-to-ut      | Cotton grass                 |
| Mu-yu-to          | Race                | Nak-a-tow-gu-to  | Screw                        |
| Mu-uk-to-uk       | Cotton              | Nak-ko-ga-gu     | You love                     |
| Muk-ig-a          | Purifier            | Nak-ko-ga-ra     | I love                       |
| Muk-ut            | Not enough          | Nak-ko-ru-uk     | Snail                        |
| Muk-uk            | Damp                | Nak-ko-pe-yuk to | Excellent                    |
| Muk-uk-to-ru      | Damp ground         | Nak-ko-ra        | Good                         |
| Mu-ka-ut          | That                | Nak-gu           | A dart                       |
| Mu-ru-uk          | Ice mass            | Nak-gu-chuk      | A root                       |
| Mu-ru-to-ru-uk    | Spread              | Nak-ut           | Cracked                      |
| Mu-ru-ru-uk       | Four rows           | Nak-ut-gu-ut     | Write now                    |
| Mu-ru-ru-uk-to-ru | Sand gull           | Nak-ut-uk        | Soil snow                    |
| Mu-ru-ru-wat-ru   | Red spear           | Nak-ut-ut        | Snail fly                    |
| Mu-ru-ru-uk       | Weathered           | Nak-ut-uk-gu     | Hook and tackle              |
| Mu-ru-ru-uk       | Drumstick           | Nak-ut-a-mu      | A while                      |
| Mu-ru-ru-uk       | Woolen sock         | Nak-ut-ko        | Wait by and by               |
| Mu-ru-ru-uk       | Ice saw             | Nak-ut-pah       | Where                        |
| Mu-ru-ru-uk       | Ice                 | Nak-ut-uk-uk     | Trap                         |
| Mu-ru-ru-uk       | Ice                 | Nak-ut           | When                         |
| Mu-ru-ru-uk       | Ice                 | Nak-ut-to-ru     | Carry by a strap             |
| Mu-ru-ru-uk       | Ice                 | Nak-ut           | White bear                   |
| Mu-ru-ru-uk       | Ice                 | Nak-ut           | Paint imminent               |
| Mu-ru-ru-uk       | Ice                 | Nak-ut           | Lamp                         |
| Mu-ru-ru-uk       | Ice                 | Nak-ut           | Maple tree                   |
| Mu-ru-ru-uk       | Ice                 | Nak-ut           | Ice                          |
| Mu-ru-ru-uk       | Ice                 | Nak-ut           | Flag staff                   |
| Mu-ru-ru-uk       | Ice                 | Nak-ut           | A hand                       |
| Mu-ru-ru-uk       | Ice                 | Nak-ut           | Existent                     |
| Mu-ru-ru-uk       | Ice                 | Nak-ut           | I want to eat                |
| Mu-ru-ru-uk       | Ice                 | Nak-ut           | Stomach                      |
| Mu-ru-ru-uk       | Ice                 | Nak-ut           | You eat                      |
| Mu-ru-ru-uk       | Ice                 | Nak-ut           | Contents of a deer's stomach |
| Mu-ru-ru-uk       | Ice                 | Nak-ut           | Hooded                       |
| Mu-ru-ru-uk       | Ice                 | Nak-ut           | Hat                          |

|                            |                                           |                               |                          |
|----------------------------|-------------------------------------------|-------------------------------|--------------------------|
| <b>Na shat'to ol'ok</b>    | Plover                                    | <b>Note chok'to ne</b>        | Seal liver               |
| <b>Naah'echuk</b>          | Bareheaded                                | <b>Ne u ge uk che gab cha</b> | Big girl                 |
| <b>Naah'oan</b>            | Hood                                      | <b>ok</b>                     |                          |
| <b>Naah'ow a tuk</b>       | Cap                                       | <b>Ne u ge uk peah che ak</b> | Little girl              |
| <b>Na tah'ga</b>           | Bottom                                    | <b>Ne u ge uk'suk</b>         | Young girl               |
| <b>Na tak ko ok</b>        | Gristle                                   | <b>Ne u ge uk'sow ro</b>      | Young girls              |
| <b>Na tak'took</b>         | Turbot                                    | <b>Ne uke</b>                 | Leg                      |
| <b>Na tang'noh</b>         | Turbot                                    | <b>Ne uk'toon</b>             | Drill                    |
| <b>Nat'chan'a bur o</b>    | A gull                                    | <b>Ne upe kok'to</b>          | Mirage                   |
| <b>Nat'cheet</b>           | Floor                                     | <b>Nev'a ya</b>               | Scaly-skin disease       |
| <b>Nat'chik</b>            | Common seal                               | <b>Ne wing nok'to</b>         | Hang                     |
| <b>Nat'chum ok</b>         | Ceremony of offering water to a dead soul | <b>Ne'yak</b>                 | North                    |
|                            |                                           | <b>Ne'yok</b>                 | Snare                    |
| <b>Nat'kah</b>             | Bottom                                    | <b>Nib an buk</b>             | Blue-bottle fly          |
| <b>Nat'kat ka</b>          | Press                                     | <b>Nih la ro'ak</b>           | In labor                 |
| <b>Nat'koh a lok</b>       | Down                                      | <b>Ni chow'e lo</b>           | Strike me again          |
| <b>Nat'ma'at</b>           | Family                                    | <b>Ni chuh'tuk</b>            | Carbine                  |
| <b>Nat'moota</b>           | Gizzard                                   | <b>Ni'chuk</b>                | Short                    |
| <b>Nat'mow tung a</b>      | Strap                                     | <b>Nig a tok' puk</b>         | Crab                     |
| <b>Na to'a</b>             | Top                                       | <b>Nig a tu' too</b>          | Small tassels            |
| <b>Na tuk'kwo</b>          | Nostril                                   | <b>Nig er ah</b>              | Tassel                   |
| <b>Na whik'ka</b>          | Break                                     | <b>Nig er ah teet'ka</b>      | Fringes                  |
| <b>Na whik'tu it</b>       | Broken                                    | <b>Nik'ik</b>                 | West                     |
| <b>Na wih'kung a</b>       | Groom                                     | <b>Nik'chik</b>               | Fish-hook                |
| <b>Na wing a wu</b>        | Bench                                     | <b>Nin'cha</b>                | Aunt                     |
| <b>Na wing'chuk</b>        | Not bend                                  | <b>Ning'e rook</b>            | Pull down                |
| <b>Na yung a</b>           | Nod                                       | <b>Nin vok</b>                | Cottonwood               |
| <b>Na yung ok to</b>       | Nodding                                   | <b>Nip ko</b>                 | Dried                    |
| <b>Naz'ra vol</b>          | Lake, sheet, muslin                       | <b>Nip pe</b>                 | Loud                     |
| <b>Naz'ruk</b>             | Abdomen                                   | <b>Nip ter uk</b>             | Burrow                   |
| <b>Ne ah'zrook</b>         | Eat                                       | <b>Nip ti luk</b>             | Thick weather            |
| <b>Ne ak a mo</b>          | Tea-pot                                   | <b>Nip tok'took</b>           | Good weather             |
| <b>Ne ak ko ko</b>         | Head                                      | <b>Nuh egok'tuk</b>           | Leaping                  |
| <b>Ne ak'kwuk</b>          | Tea-broth                                 | <b>Ni shoo'ra</b>             | Short                    |
| <b>Ne ar a'chuk too ma</b> | I am hungry                               | <b>Ni tu ruk</b>              | Short one                |
| <b>Neg a lok</b>           | Bent                                      | <b>Ni ya</b>                  | Sister                   |
| <b>Ne ge a</b>             | North                                     | <b>Ne ak ala o ta</b>         | Suspenders               |
| <b>Ne geb li boy</b>       | Knuckle                                   | <b>Noh a lute'ka</b>          | Knee                     |
| <b>Ne ge uk tuk</b>        | Sun dog                                   | <b>Nog a rook</b>             | Horn                     |
| <b>Ne goo o</b>            | Ringworm                                  | <b>Nok a e lun</b>            | Collar                   |
| <b>Ne gung a</b>           | Negative                                  | <b>Nok a week'shu</b>         | Ugly                     |
| <b>Ne kah't</b>            | Beard or nose                             | <b>Nok e rook</b>             | Venerical disease        |
| <b>Nek a we</b>            | Leg of meat                               | <b>Nok e ru</b>               | Stiff                    |
| <b>Nek a wih</b>           | Dining table                              | <b>No ko nok</b>              | Hornacle                 |
| <b>Nek a yok to</b>        | You eat                                   | <b>Nok'su</b>                 | Drill brace              |
| <b>Nek eh</b>              | Meat, flesh                               | <b>Nok'tero'a</b>             | Hang up                  |
| <b>Nek eh ak che rook</b>  | Plenty of meat                            | <b>Nok to ak we it</b>        | Button hole              |
| <b>Ne kpe'ak to</b>        | Not enough                                | <b>Nok tok to'a</b>           | Crossing                 |
| <b>Ne kow'wik</b>          | Table                                     | <b>Nok to ret</b>             | Long horse               |
| <b>Ne kow'yan</b>          | Tetter                                    | <b>Nom a yot hut</b>          | Edible bush              |
| <b>Ne kwo'chuk</b>         | Not good                                  | <b>Nong neh sret</b>          | A pool of water          |
| <b>Nel a kok</b>           | High                                      | <b>Nom ma ta</b>              | Strap                    |
| <b>Nel a kow'ruk</b>       | Partabons                                 | <b>Noo'ah</b>                 | Shovel                   |
| <b>Nel a ru</b>            | Don't know                                | <b>Noo a luk</b>              | Snipe                    |
| <b>Nel a ru it</b>         | I don't know                              | <b>Nook a</b>                 | Brother, or sister       |
| <b>Ne la to</b>            | Meat                                      | <b>Nook ah ah</b>             | Flour                    |
| <b>Nel a we'ga</b>         | Unknown                                   | <b>Nook a ta'ya</b>           | Pull                     |
| <b>Ne lepton</b>           | Forward                                   | <b>Noon a</b>                 | World, earth, land       |
| <b>Ne ling ne</b>          | Forward                                   | <b>Noon a koop'er uk</b>      | Earthquake               |
| <b>Ne loong a</b>          | Nipple                                    | <b>Noonate a</b>              | Abandoned                |
| <b>Ne ming a</b>           | Laughing                                  | <b>Noon a sin'ik</b>          | Dead, sleeping on ground |
| <b>Ne pe'le ak shok</b>    | Middle of sun                             | <b>Noong a kok to ro a</b>    | Big nose                 |
| <b>Ne pe'to</b>            | Stuck together                            | <b>Noo noo uk'to ak</b>       | Pinch                    |
| <b>Ne put'e to it</b>      | Cross up                                  | <b>Noo wou'jek</b>            | Snow clouds              |
| <b>Ne rah ak'puk</b>       | Well                                      | <b>Noo wout ka</b>            | End, consumed            |
| <b>Ne sho ne</b>           | This side of                              | <b>Noo'ya</b>                 | Hair of head             |

|                      |                             |                        |                       |
|----------------------|-----------------------------|------------------------|-----------------------|
| Now aak tuk          | Moon first quarter          | Og a la tu tin         | Are you writing       |
| Now a luk            | Whale spear                 | Og a lok               | Brown bear            |
| Now a yak to         | Lat                         | Og a ra lu it          | Wheel                 |
| Now chet             | Wild onion                  | Og a ro                | Morning star          |
| Now chok             | Young deer                  | Og a wik               | Anvil                 |
| Now chyo uk          | Embryo deer                 | Og la nah              | Pencil                |
| Now lau uk           | Strump                      | Og la na ok to         | Gun                   |
| Now ro               | Grow                        | Og la ni tuk           | Continue              |
| Now yak              | Large gray gull             | Og lek to ak           | Menses                |
| Now yak a a          | Scalloped shell             | Og lo un               | Pencil                |
| Now yang a ok to pe  | Don't want to eat it        | Og luk to              | Writing               |
| Now yate             | Onion                       | Og na zek to ak        | Evil minded           |
| Now yook             | Fishing                     | Og ra ot               | Starfish              |
| Now yorok tuk        | Hopping                     | Ok ah pit              | Rise up               |
| Now yok to           | Eat                         | Ok a le gamah          | Grow                  |
| Nu bol a tu          | New moon                    | Ok an a sel a          | Hen                   |
| Nu ch ot             | Hair of the head            | Ok an a shu rok        | Hitch                 |
| Nu e gelu            | Friend                      | Ok an to               | Woman                 |
| Nu e yok a tok       | Long mosquito               | Ok an ok               | Woman female          |
| Nu e yok to ak       | Grasp                       | Ok an ot               | Women                 |
| Nu gal lo a          | All right                   | Ok an ow rok           | Girl                  |
| Nu gat che a         | Brother                     | Ok a ng a rok          | Old woman             |
| Nu gat che a         | Sister                      | Ok a tuk               | Football              |
| Nu gat pe a          | Young man                   | Ok a rok chute         | Gun upple             |
| Nu gat pe ch to      | Young man                   | Ok a ru luk chuk to ak | Fat of a stag         |
| Nu gat pe z to       | Boys                        | Ok a tu na             | Powder                |
| Nu ka nu ta to lo na | Married to two sisters      | Ok a tu to             | My wife               |
| Nuk ko ovuk          | Stand                       | Ok a ve                | Ashes                 |
| Nuk pah              | Ball                        | Ok a vi tin            | He scented            |
| Nuk pah ah           | Fastness, spright           | Ok a yoke va           | Hasten                |
| Nuk pe tuk           | Upright piece of a tree     | Ok chel uk to          | Turn over             |
| Nuk pung a           | Tossing up a ball with foot | Ok eruk                | Ashes                 |
| Nuk to ak            | Avocet or plover            | Ok a wuk               | Bow head whale        |
| Nu lo a              | Wife                        | okke kwik tuk          | Agate                 |
| Nu lo a lo a         | Maid                        | Okke oak               | Appetite              |
| Nu lo a lo a che     | Can't keep a wife           | okke oak ke chuk       | No appetite           |
| Nu lo a to           | Wife                        | Okke oak ke to a       | Big appetite          |
| Nu lo a to che a     | Keep her                    | Ok ko                  | Paddle                |
| Nu lo a to che a     | Maid                        | Ok ko ra               | Lower border of dress |
| Nu lo a to che a     | Maid                        | Ok ko ra ch            | Crane                 |
| Nu lo a to che a     | Hope                        | Ok ko uk               | Exit                  |
| Nu lo a              | Root                        | Ok la na               | Rope                  |
| Nu lo a to           | Curstard                    | Ok lo nok              | Rope                  |
| Nu lo a to           | Evening star                | Ok ko to ta ko a       | Deserted              |
| Nu lo a to a         | Stake                       | Ok ko to ta ko a       | Scales to weigh       |
| Nu lo a to a         | Stake                       | Ok ko to ta ko a       | Heavy                 |
| Nu lo a to a         | Stake                       | Ok ko to ta ko a       | Set down              |
| Nu lo a to a         | Stake                       | Ok ko to ta ko a       | Plattingan            |
| Nu lo a to a         | Stake                       | Ok ko to ta ko a       | Hashed plattingan     |
| Nu lo a to a         | Stake                       | Ok ko to ta ko a       | Sea quail             |
| Nu lo a to a         | Stake                       | Ok ko to ta ko a       | Finches               |
| Nu lo a to a         | Stake                       | Ok ko to ta ko a       | Carriage              |
| Nu lo a to a         | Stake                       | Ok ko to ta ko a       | Run                   |
| Nu lo a to a         | Stake                       | Ok ko to ta ko a       | Run fast              |
| Nu lo a to a         | Stake                       | Ok ko to ta ko a       | Sea quail             |
| Nu lo a to a         | Stake                       | Ok ko to ta ko a       | Wheel                 |
| Nu lo a to a         | Stake                       | Ok ko to ta ko a       | Sweeten               |
| Nu lo a to a         | Stake                       | Ok ko to ta ko a       | Roll                  |
| Nu lo a to a         | Stake                       | Ok ko to ta ko a       | Rolling               |
| Nu lo a to a         | Stake                       | Ok ko to ta ko a       | Half                  |
| Nu lo a to a         | Stake                       | Ok ko to ta ko a       | Phizzard              |
| Nu lo a to a         | Stake                       | Ok ko to ta ko a       | Long                  |
| Nu lo a to a         | Stake                       | Ok ko to ta ko a       | Hope to off           |
| Nu lo a to a         | Stake                       | Ok ko to ta ko a       | Squat                 |
| Nu lo a to a         | Stake                       | Ok ko to ta ko a       | Phalarope             |
| Nu lo a to a         | Stake                       | Ok ko to ta ko a       | Sig                   |

|                         |                      |                          |                           |
|-------------------------|----------------------|--------------------------|---------------------------|
| <b>Ok via i le'no</b>   | Six of them          | <b>Oo'kok</b>            | Tongue                    |
| <b>Ok wook'suk</b>      | Old woman            | <b>Ooko me'a</b>         | Chew of tobacco           |
| <b>Ole ma gow'ruk</b>   | Hatchet              | <b>Ookpe gi'lo</b>       | Young owl                 |
| <b>Ole'mah</b>          | Adze                 | <b>Ook'peek</b>          | Snowy owl                 |
| <b>Ol le'ro</b>         | Move                 | <b>Ook'pnt'ik</b>        | Lower part of back        |
| <b>Ole'ruk</b>          | Fall over            | <b>Ook'sruk</b>          | Oil, fat, or lard         |
| <b>On'e ruok</b>        | Birth                | <b>Ook'toon</b>          | Square (a tool)           |
| <b>On e'ru</b>          | Out                  | <b>Oo kwad'hook'puk</b>  | Salmon                    |
| <b>On e'zruk</b>        | Out                  | <b>Oo kwad'lu'puk</b>    | Trout                     |
| <b>Ong a na'yok</b>     | To point             | <b>Oo kwah</b>           | Those                     |
| <b>Ong'a ru</b>         | Big                  | <b>Oo kweawk'too</b>     | Around here               |
| <b>Ong a yak'ito</b>    | Enemy                | <b>Oo kweet'a</b>        | Saddle of venison         |
| <b>Ong'a yo</b>         | Elder brother        | <b>Oo kwil'awk</b>       | Calico, cloth             |
| <b>Ong a yo kog'ara</b> | Old animal           | <b>Oo kwok'to</b>        | Talk                      |
| <b>Ong a yo kog'nek</b> | Old man              | <b>Ook'wok'ton</b>       | Said                      |
| <b>Ong a yo kong'ek</b> | Father-in-law        | <b>Ook'wok'to'ma</b>     | Silly                     |
| <b>Ong a zhu'a</b>      | Age                  | <b>Oolapkit'ke</b>       | A game of tag             |
| <b>Ong a zru'it</b>     | Very large           | <b>Oo leh</b>            | Red                       |
| <b>Ong a zru'rum</b>    | Very large           | <b>Oolek shuk</b>        | Split                     |
| <b>Ong eg'a to'a</b>    | Excessive            | <b>Oole'kret</b>         | Erase                     |
| <b>Ong e'go tin</b>     | You consent          | <b>Oo lo la'go</b>       | Open out, turn inside out |
| <b>Ong ek'to</b>        | I consent            | <b>Oole ma</b>           | Axe                       |
| <b>Ong e'zruk</b>       | Big                  | <b>Oo le'to</b>          | Back sinew                |
| <b>Ong muk</b>          | A gate               | <b>Ool ge'lik</b>        | Blanket                   |
| <b>Ong ne'a</b>         | Stopped up           | <b>Oo lig'rua</b>        | Blanket                   |
| <b>Ong'nek</b>          | Elder sister         | <b>Oo lik'to'a</b>       | Shiver                    |
| <b>Ong'ruk</b>          | Darkness of night    | <b>Ooling'le lok</b>     | Tumble                    |
| <b>Ong'toon</b>         | Male                 | <b>Oolook'ah</b>         | Sawdust                   |
| <b>Ong o'wok'to</b>     | To paddle            | <b>Ooloon</b>            | A saw, or woman's knife   |
| <b>Ong ung'ek</b>       | Mother-in-law        | <b>Ooloo-ok'toon</b>     | A saw                     |
| <b>Ongus'rite</b>       | Current              | <b>Oo loo'ra</b>         | Woman's knife             |
| <b>Ong'you</b>          | Comrade              | <b>Ooloo'raken</b>       | Cheek                     |
| <b>On us'ruk</b>        | Currents             | <b>Ooloo'ra me</b>       | Cut with woman's knife    |
| <b>Ong ik'lik</b>       | Pursuers             | <b>Oola gah</b>          | Crush                     |
| <b>Ong'bite</b>         | Door-existence       | <b>Oomagih'to</b>        | Get out                   |
| <b>Ong'wah</b>          | Talisman             | <b>Ooma</b>              | My husband                |
| <b>On nok</b>           | Slate                | <b>Ooma la</b>           | Rich man                  |
| <b>On na ke'ga</b>      | Game of tag          | <b>Ooma'lik</b>          | Chief or head man         |
| <b>On n a we'lok to</b> | Jump up and down     | <b>Ooma'ruk</b>          | Stiff                     |
| <b>Ooban'ruk</b>        | One bottle of        | <b>Ooma ya</b>           | Shave                     |
| <b>Ooblah'o</b>         | To-morrow future     | <b>Ooma ya</b>           | Chief or head man         |
| <b>Ooblow'rot</b>       | Cottonwood           | <b>Oome'ak</b>           | An open boat              |
| <b>Oobluke</b>          | Day's got            | <b>Oome'ak'puk</b>       | Ship                      |
| <b>Oobluke'lok'to</b>   | Future existence     | <b>Oome'ak'tuk</b>       | Ship                      |
| <b>Ooblu'puk</b>        | Day from now to ever | <b>Oome'chat</b>         | Reindeer moss             |
| <b>Oobrow'it</b>        | Big mouse            | <b>Oome'chuk'too</b>     | Hate                      |
| <b>Ooching'no'ik</b>    | Large wheel          | <b>Oome'lok'to</b>       | Making faces              |
| <b>Oochuk</b>           | Spring gun           | <b>Oomen</b>             | Mountain                  |
| <b>Ooo al'go</b>        | Gargle               | <b>Oome'tot</b>          | Capsize boat              |
| <b>Ooo la'h</b>         | Chew of tobacco      | <b>Oome'shuk'tuk</b>     | Mislike                   |
| <b>Oogal'k</b>          | Have                 | <b>Oome'ug'ank'to'ak</b> | Boat festival             |
| <b>Oog a'ruk</b>        | Seal on              | <b>Oome'uk'kuk</b>       | Open it                   |
| <b>Oo gin'ek'tuk</b>    | Completed            | <b>Ooming'a'rok'took</b> | Close                     |
| <b>Oogrunk'ok</b>       | Gray mouse           | <b>Oomig'lage</b>        | Shut                      |
| <b>Oogung'a</b>         | White scar           | <b>Oomik'tine</b>        | Mustache                  |
| <b>Oo in'yok'to</b>     | Whistle              | <b>Oomoot'gum'e</b>      | Heavy                     |
| <b>Ookalik</b>          | Have                 | <b>Oooduk'uk</b>         | South wind                |
| <b>Ook'aruk</b>         | Old                  | <b>Oomuh</b>             | Mag, compass              |
| <b>Ook a'ru'a</b>       | Soft                 | <b>Oomuh</b>             | Oh, you!                  |
| <b>Ooke'ok</b>          | Back tower           | <b>Oome'k shuk</b>       | Am                        |
| <b>Ooke'ok</b>          | Year, winter         | <b>Oome'k'tine</b>       | Mustache                  |
| <b>Ooke'ok'to</b>       | Autumn               | <b>Oome'k'tuk</b>        | Am                        |
| <b>Ooke'ok'tuk</b>      | Autumn               | <b>Oomon</b>             | Heart                     |
| <b>Ooke u'a'ruk'tuk</b> | December moon        | <b>Oomung'mong</b>       | Musk-ox                   |
| <b>Ooke uk'ton'ruk</b>  | Snow bird            | <b>Oomutah</b>           | Heart                     |
| <b>Ooke'ulik</b>        | Winter game          | <b>Oon'a</b>             | It                        |



|                |                          |                |                         |
|----------------|--------------------------|----------------|-------------------------|
| Onah           | Whale and walrus sp. ar. | Ow-wi-a        | Shell                   |
| Oni-aoot       | For                      | Ow-wing-a      | Husband                 |
| Oni-wi-ne      | Sea                      | Ow-wi-nk       | Human skin              |
| Oni-shed-nek   | Cross                    | Ow-wik-to      | Crumble                 |
| Oni-a-zrok-tuk | One may sled             | Ow-wi-on-a     | Over there              |
| Oni-ne-ah      | Drag                     | Ow-wig-out     | We, us                  |
| Oni-ne-ot      | Sled                     | Ow-wi-nk       | Warbler                 |
| Oni-cho        | It is from               | Ow-wing-a      | I, me, mine             |
| Oni-nek        | Must be                  | Ow-wing-a-loo  | Ours                    |
| Ong-a-lu       | South, south wind        | Ow-wi-lu       | Rock                    |
| Ong-a-ne-nek   | Little                   | Ow-wi-wik      | Rock                    |
| Ong-nah-pul    | Night                    | Ow-yeg-a-ya    | To dress                |
| Ong-nek        | Night                    | Ow-wi-nk       | Rock                    |
| Ong-mo-ka      | Muscle loading gun       | *Ow-lung-ok    | Vent                    |
| Ongok-ak-ka-ka | Sweet                    | Ow-lum-a-ga    | Needle case             |
| Ongok-wi       | Fir                      | Ow-zrok        | Smooth tanned seal-skin |
| Ongok-to       | Hot                      | Ow-kwa-a-to    | This side               |
| Ongok-tut      | Hot                      | Ow-kwa         | Trump                   |
| Ongoo-moo      | Yesterday                | Ow-pul-bul-luk | A species of small bird |
| Ongoo-nek-a-ot | Four deer skin           | Ow-ku-nk       | Fire clay               |
| Oupin-ak       | Summer                   | Ow-yowk        | Monkey wrench           |
| Oupin-pow-luk  | Warbler                  | Ow-ko-wi-kon   | Black lead              |
| Oupin-yig-a-ka | Summer                   | Ow-kuk-to      | Bag of oil              |
| Oupin-yo-a-ka  | Chastise                 | Ow-lo-ka       | Mittens                 |
| Oupin-nek      | Post                     | Ow-luk         | Name of a thing         |
| Oupin-tul      | Supper                   | Ow-ka          | Other                   |
| Oupin-uk       | It is so                 | Ow-nuk         | Crow bill duck          |
| Oupin-nuk-wi   | Strong                   | Ow-pul         | Empire                  |
| Ow-tah-ka      | Meadow                   | Ow-a-nuk       | Vine                    |
| Ow-pu-ka       | Ice                      | Ow-cho-to      | Yawn                    |
| Ow-luk         | Melt, get out of ice     | Ow-ka          | Pieces                  |
| Ow-luk-ut-ka   | Thaw                     | Ow-ka-to       | Soft                    |
| Ow-luk-ka      | Thawing                  | Ow-ga-ka       | Philadelp.              |
| Ow-luk-wi-ka   | Strong, cold             | Ow-luk         | Lead silver             |
| Ow-luk         | Thaw                     | Ow-wi-gow      | Looking                 |
| Ow-luk-to      | Refuse                   | Ow-ka          | Blind                   |
| Ow-luk-wi      | Refuse                   | Ow-ka          | Melt                    |
| Ow-luk-wi-to   | Refuse                   | Ow-luk-luk-ga  | Melting                 |
| Ow-luk-wi      | Awake                    | Ow-luk-to      | Reed                    |
| Ow-luk-wi      | Refuse                   | Ow-luk-wi      | Get out                 |
| Ow-luk-wi-ka   | Refuse                   | Ow-luk-wi-luk  | Reed                    |
| Ow-luk         | Unseen                   | Ow-luk         | Sun                     |
| Ow-luk-wi      | Unseen                   | Ow-luk         | Engle                   |
| Ow-luk-wi      | Refuse                   | Ow-luk         | Motion                  |
| Ow-luk         | Wet                      | Ow-luk         | Star                    |
| Ow-luk-wi      | Sea                      | Ow-luk         | Hard, mixer, head cook  |
| Ow-luk-wi      | Unseen                   | Ow-luk         | Stake                   |
| Ow-luk-wi      | Unseen                   | Ow-luk         | Wave                    |
| Ow-luk-wi      | Unseen                   | Ow-luk         | Movement                |
| Ow-luk-wi      | Unseen                   | Ow-luk         | Charcoal                |
| Ow-luk-wi      | Unseen                   | Ow-luk         | Prize, dotted blood     |
| Ow-luk-wi      | Unseen                   | Ow-luk         | Not bloody              |
| Ow-luk-wi      | Unseen                   | Ow-luk         | Abuse                   |
| Ow-luk         | Unseen                   | Ow-luk         | Drop                    |
| Ow-luk-wi      | Unseen                   | Ow-luk         | Some game               |
| Ow-luk         | Unseen                   | Ow-luk         | Deal                    |
| Ow-luk-wi      | Unseen                   | Ow-luk         | A ball                  |
| Ow-luk         | Unseen                   | Ow-luk         | String shot             |
| Ow-luk-wi      | Unseen                   | Ow-luk         | String puzzle           |
| Ow-luk-wi      | Unseen                   | Ow-luk         | Stir                    |
| Ow-luk-wi      | Unseen                   | Ow-luk         | Paper                   |
| Ow-luk-wi      | Unseen                   | Ow-luk         | State                   |
| Ow-luk-wi      | Unseen                   | Ow-luk-wi-luk  | Extreme, where          |
| Ow-luk-wi      | Unseen                   | Ow-luk         | Ventile                 |
| Ow-luk-wi      | Unseen                   | Ow-luk-wi-luk  | Frying pan              |
| Ow-luk-wi      | Unseen                   | Ow-luk-wi-luk  | A game of cards         |

|                       |                   |                      |                            |
|-----------------------|-------------------|----------------------|----------------------------|
| Pah chok'to           | To pass (cards)   | Pe too whok'to       | Roll over                  |
| Pah haw'ta            | Whip              | Pe u'ka              | Pinch                      |
| Pah'hine              | Come (to a child) | Pe uk'pah            | Failed                     |
| Pah ket'ke gah        | Find              | Pe uk to ak          | Full                       |
| Pah kow'e cho         | Not found         | Pe yek'in            | Get away                   |
| Pah look'to           | Beaver            | Pe yek'pun           | Is gone                    |
| Pah muk'too           | Crawl             | Pe yek'tin           | Begone                     |
| Pah mung'nah          | East              | Pe'yok               | Clean out                  |
| Pah'ne                | Off               | Pe yowk tin          | You are wanted             |
| Pah ret'a             | Crook             | Pe yuk'suk           | Throw                      |
| Pah wun'e             | Through           | Pig'a                | Many                       |
| Pal ig'er ak'tow tik  | Lastful           | Pig'a ren            | Present                    |
| Pal lo tuk            | Kind of moss      | Pig's zoot           | Shovel                     |
| Pal uk'tel            | Dam               | Pik a tet ka         | Present me                 |
| Pan'e                 | Hoisted           | Pik a rum nik        | Give me food               |
| Pan ek'ta             | Dried             | Pik cho'in           | Razor                      |
| Pan nang ne ak to     | Back inland       | Pil girok            | Plait                      |
| Pan'ning              | Daughter          | Pilot'a shu'ra       | Too slow                   |
| Pa room'a             | Kite              | Pi luk'tuk           | No more                    |
| Pat chu ang a         | Not find          | Pin ek'tou           | Pocket-knife               |
| Pat kou lak took      | Fan               | Ping'i shute         | Three                      |
| Paw wun'e             | Through           | Ping'ishu'nek        | Three of them              |
| Pe'ya                 | Hatch             | Ping'ishu-okvin ille | Eight                      |
| Pe ah'a rook          | Killed            | Pn'uhuk              | Stocking                   |
| Pe a'le go            | Take off          | Pm ukuk              | Short deer-boots           |
| Pe che kok'tung       | Strike against    | Pm u'kunuk           | Stocking                   |
| Pe che kuk tuk too    | Bump              | Pm u'loo             | Bread-pan                  |
| Pe chik che lek'to ak | Fry               | Pm u'ra              | Slippers                   |
| Pe'chuk               | Will not          | Pm u'rooa            | Nettle-rash                |
| Pe chung'e cho        | Not wanted        | Pm u'tok             | Pocket-knife               |
| Pe chu nok'rok to ak  | Walked            | Pm va ago'ra         | File                       |
| Pe chu ru'ik          | Walk              | Pu'yok               | Grass to put in boots      |
| Pe e ga lu tin        | Intercourse       | Pm yow'a             | File                       |
| Peg a                 | Take off          | Pm yowk'toonga       | Filling                    |
| Pe'gah                | Has               | Pm yuk'ta            | Pocket-knife               |
| Pe'gown               | They want         | Pm yuk'tow'a         | Pocket-knife               |
| Pe gow'tin            | You are wanted    | Pe'la ra             | Dance                      |
| Pe ke to oy ak        | Kick              | Pogatow'ro           | Dish, plate, pan           |
| Pe kok'tu             | Shove             | Pok chagah'yah       | Will meet                  |
| Pe koo'le gah         | Turn, back        | Pok'oy               | Receptacle                 |
| Pe kun'e              | On there          | Pok no'ra ok         | Ice window                 |
| Pe kwah               | Loos              | Polahto'a            | Eclipse                    |
| Pe'lege               | Bring             | Pola ruk             | Doing                      |
| Pe lek'ta             | Out out           | Poluk'tuk            | Stoop                      |
| Pe la                 | Intercourse       | Pood nun'tuk         | Tallow                     |
| Pe luk                | Not here          | Poo oy tuk           | Blister                    |
| Pe ne la tin          | None              | Poo eyuk             | Craw                       |
| Pe nik'erat           | Grass             | Poo eyowk tuk        | Vapor                      |
| Pe nik'era ne         | On the grass      | Poo'ra               | Receptacle                 |
| Pe now gan            | File              | Poo'rat to it        | Swim                       |
| Pe rik'a              | Bent              | Pook'ke              | White hair on deer's belly |
| Pe rik tok to tin     | Around the bend   |                      |                            |
| Pe shik'che tok       | Drill handle      | Pook chak tuk        | Excrement                  |
| Pe shik'che           | A bow             | Pook'chook           | A seal bag                 |
| Pe shik'che rok       | A gun spring      | Pook tow to          | Bovy                       |
| Pe shook'a wah        | What do you wish  | Poo'ga               | Shroud                     |
| Pe shook kel ask to   | Seed              | Poon'ik              | Bread                      |
| Pe shook kok          | White fox         | Pooto                | Ear ring                   |
| Pe shook'took         | Wet               | Pooto'a              | Hole                       |
| Pe shu ok too         | Walking           | Pootogwok'wahoyik    | Glow worm                  |
| Pe shu'ra             | Wall              | Pootoo'ga            | Big toe                    |
| Pete pe la'rus        | None              | Pootook'e to         | Stumble                    |
| Pete pe rak           | None              | Poo'w'ok             | Lung                       |
| Pete pi yak to        | Not anything      | Poo'we               | Blister                    |
| Pe tik'to             | Shoot             | Poo'ye ga            | Craw                       |
| Pe took kah too'a     | Polse             | Poo'yoka'wik         | Stove pipe                 |



|                  |                   |                   |                          |
|------------------|-------------------|-------------------|--------------------------|
| Powlyuk          | Steam             | Se lung'ok        | Black tanned leather     |
| Pot ka           | Marrow            | Se na toak'too na | Dream                    |
| Pot ka tel nok   | Marrow bone       | Se ne'a           | Bootlace                 |
| Pot low'ch'a lo  | Clapping of hands | Se nung'koot      | Ankle                    |
| Pot to mas       | Wish bone         | Se rook'ta at a   | Take it                  |
| Pow a'ha to      | Guarded           | Se sam an'th      | Four of them             |
| Pow'et to a      | Swollen           | Se sam at         | Four                     |
| Pow'haa a        | Wide awake        | Se tange'rook     | Handsome                 |
| Pow lah          | Soot              | Se ta vo'ruk      | Herring                  |
| Pow la'yo        | Renovated         | Se tik            | Ear                      |
| Pow'oke to       | Forget            | Se to luk         | No ear                   |
| Pow'she          | Cup               | Se to'lat         | Ear of an animal         |
| Poyoke'pe'la'et  | Forget about it   | Se'uk se tik      | Bird snare               |
| Poyrok'tet       | Forget            | Se'uk saw se tik  | Embargo                  |
| Pubo'greet       | Whale's small     | Shag'a            | Whale's stomach          |
| Puk la'va'ok     | Flea              | Shah'tuke a'tig a | Open cloak               |
| Puk'na           | At present        | Shah'tu ruk       | Very thin                |
| Puk'mum'noy      | Now               | Shah'tu to        | Misdeed                  |
| Puk'to'ok        | Next              | Shah'to'kok       | Side                     |
| Pum'to'ma'na     | Fast              | Shah'to'ka'a'vu'k | Periwinkle               |
| Pum'noy'ou'yo    | Animal's tail     | Shah'tu           | Thin                     |
| Pum'noy'uk'tok   | Land otter        | She               | Pike (fish)              |
| Pum'noy'ung'a    | Animal's tail     | She'la'look       | Rain                     |
| Pum'a            | Daughter          | She'la'look to    | Ranting                  |
| Pum'el'kie       | Over-reaching     | She'lik to'a      | Large gloves & needle    |
| Pum'ga           | Commonly          | She'lu'te         | Bundle up                |
| Pum'guk          | Stage             | She'ook           | Pike (fish)              |
| Pum'no'a         | Daughter          | She'ong'a'ruk     | Rising water             |
| Pum'noy          | A staff           | She'ra'ng         | Woman's pantaloons       |
| Pum'noy'at'ook   | Spring season     | She'to'p'a'ruk    | Seven stars              |
| Pum'noy'ou'a     | Land porpoise     | She'sh'ook        | White grampus            |
| Pum'noy's'ok'ok  | Deadly            | She'to'va'ok      | White grampus            |
| Pum'noy'sh'ok'ok | Deadly            | She'wa            | Flow of a vessel         |
| Pum'ok'to'ok     | Leaf              | Shah'tu'va        | Sun                      |
| Pum'ok'to'et     | Worm-eaten        | Shah'to'et        | Short days               |
| Pup'a            | Redstart          | Shah'to'vo'ruk    | No sun                   |
| Put'a'au'et      | Potato            | Shah'to'v'ok      | Lame                     |
| Pu'wa'au'et      | Unseasoned        | Shah'to'v'ok      | Which                    |
| Pu'wa'to'et      | Unseasoned        | Shah'to'v'ok      | Killed                   |
| Sa'to'au'et      | Unseasoned        | Shah'to'v'ok      | Summer skin              |
| Sa'va'au'et      | Unseasoned        | Shah'to'v'ok      | Summer fur               |
| Sa'va'au'et      | Unseasoned        | Shah'to'v'ok      | Torrent, water-fall      |
| Sa'va'au'et      | Unseasoned        | Shah'to'v'ok      | Current tide             |
| Sa'va'au'et      | Unseasoned        | Shah'to'v'ok      | Ranting water            |
| Sa'va'au'et      | Unseasoned        | Shah'to'v'ok      | Ribon or whalebone       |
| Sa'va'au'et      | Unseasoned        | Shah'to'v'ok      | Arrow guides             |
| Sa'va'au'et      | Unseasoned        | Shah'to'v'ok      | Gill                     |
| Sa'va'au'et      | Unseasoned        | Shah'to'v'ok      | Shoot                    |
| Sa'va'au'et      | Unseasoned        | Shah'to'v'ok      | Gun barrel               |
| Sa'va'au'et      | Unseasoned        | Shah'to'v'ok      | What                     |
| Sa'va'au'et      | Unseasoned        | Shah'to'v'ok      | Strike, or cuff          |
| Sa'va'au'et      | Unseasoned        | Shah'to'v'ok      | Fast                     |
| Sa'va'au'et      | Unseasoned        | Shah'to'v'ok      | Slow                     |
| Sa'va'au'et      | Unseasoned        | Shah'to'v'ok      | More additional          |
| Sa'va'au'et      | Unseasoned        | Shah'to'v'ok      | What                     |
| Sa'va'au'et      | Unseasoned        | Shah'to'v'ok      | What is it               |
| Sa'va'au'et      | Unseasoned        | Shah'to'v'ok      | Put                      |
| Sa'va'au'et      | Unseasoned        | Shah'to'v'ok      | What is it               |
| Sa'va'au'et      | Unseasoned        | Shah'to'v'ok      | What do you wish         |
| Sa'va'au'et      | Unseasoned        | Shah'to'v'ok      | Don't                    |
| Sa'va'au'et      | Unseasoned        | Shah'to'v'ok      | What are your intentions |
| Sa'va'au'et      | Unseasoned        | Shah'to'v'ok      | Indifferent              |
| Sa'va'au'et      | Unseasoned        | Shah'to'v'ok      | Strong, difficult        |
| Sa'va'au'et      | Unseasoned        | Shah'to'v'ok      | Green                    |
| Sa'va'au'et      | Unseasoned        | Shah'to'v'ok      | Heads                    |
| Sa'va'au'et      | Unseasoned        | Shah'to'v'ok      | Ridge                    |

|                   |                        |                |                          |
|-------------------|------------------------|----------------|--------------------------|
| Tu room           | Your turn              | U'poo'ruk      | Knife handle             |
| Tuz ra            | That will do, did      | U'shok         | Back                     |
| Tuz rak'pe        | Not done               | U'wok          | Waistcoat                |
| Tuz ra'va         | Finished               | Wah'ok         | Dress                    |
| Tu'rum'a          | Same                   | Wam'it in      | To dress                 |
| Tu'rum, ah sing   | Same as that           | Wam'it in      | To gesticulate           |
| Tu'u              | Tree creeper           | Wan'ok'hook    | Not dirty                |
| Tu'ne'ka          | Wrist                  | We'at ok to    | Harrothed                |
| Tu'ng'ok          | A small sea bird       | We'chok        | Red head                 |
| Tu'ya'w'ke        | Hoop                   | We'it          | Sent                     |
| U'k' shok'it'u    | Lazy                   | We'la't'uk     | dim'sh                   |
| U'm'm'ig'ne       | Cham                   | Wing'at ok'ruk | Dance in honor of fiance |
| U'm'k'om          | Want little while      | Wing'ok to'ok  | Priority                 |
| U'ok'it'u'a       | Consume                | Wor'it         | Light weight             |
| U'ng'ch'u'        | Sit, sit down!         | Wo'ruk         | Light weight             |
| U'ng'a'ha't'at'et | Doctor's house         | Wol'it'u'w'uk  | Very light               |
| U'ng'a'w'it'u'    | Until                  | Wone't'uk      | Jaw                      |
| U'ng'm'u'         | Foot's house           | Yau'hook'it    | Muse                     |
| U'ng'w'ong        | Until                  | Ye'k'ek'a      | Hug                      |
| U'ng'u't'kou'a    | Doctor's house         | Ye'ok'et       | Hill                     |
| U'nt'm'ok         | Acorn                  | Ye'ok'at'u     | Live                     |
| U'nt'koo'ya       | Small canvas back duck | Yoke           | Live                     |
| U'nt'koot         | Doctor, magician       | Yor'a'yok      | A kind of fish           |
| U't'u'a           | Ax handle              |                |                          |

## NUMERALS.

- 1 A tow-shok
- 2 Hui-pah or mah-ho
- 3 Ping-tai-shate
- 4 Se-sam-at
- 5 Tai-ma
- 6 Fung-choi or tok van-de
- 7 Tai-ma-ma to-nik (5+2)
- 8 Tai-ma-ping-shu-nik (5+3)
- 9 Koi-ling o-tai-ni (1+1)
- 10 Ko-lee
- 11 E ke-tow-shok (2+1)
- 12 E ke-ma-ak
- 13 E ke-ma-ak a tow-shok
- 14 E ma-nok o-tai-ni (2+1)
- 15 E ma-nok
- 16 E ma-nok koi-nik (2+1)
- 17 Ma-ho-ke pe-ak (2+2)
- 18 Ma-ho-ke pe-ak koi-nik (2+2)
- 19 Ping-tai-shok ke pe-ak (3+2)
- 20 Tai-ma-ke pe-ak (5+2)
- 21 E ma-nok ke pe-ak (2+2)

### GEOGRAPHICAL

[illegible]

|                    |               |                  |                     |
|--------------------|---------------|------------------|---------------------|
| Light              | Kwute         | Kiss             | Sing nah a look     |
| Lie                | E-tam-ne-a    | Knife            | Wot le a            |
| Finger, first      | Tagah         | Knife            | Chow-wik            |
| Finger, second     | Ah-kh-nke     | Knife, pocket    | Om kwot wa          |
| Finger, third      | Ah-in-ne      | Know             | Ne she-muk.         |
| Finger, fourth     | E-tah-ke      | Lake             | Na peek             |
| Finger, thumb      | Kowah-uk      | Lamp             | Orik                |
| Finger nail        | Stoke         | Lance            | Kal-ho-yok          |
| Finished           | Too-plat-ko   | Land, of ice     | Nam-net             |
| Fire               | ook-took      | Leg              | It ag-o             |
| Fly                | Ma-ming-la    | Line, whale      | Pa-rekt             |
| Fly                | ook-wa        | Line, large      | Tap-kwok            |
| Fog                | Ka-got-oo     | Lip              | Kun-yuk             |
| Foreigners         | Jan-ten       | Louse            | Koo-muk             |
| Fox, red           | Hi-wah        | Lynx             | Ta-puh-let          |
| Fox, red           | Kah-yo-uk     | Man, native      | Yoke                |
| Fox, white         | Tre-gu        | Man, native      | Kol-lou             |
| Fox, white         | Too-oo        | Man, negro       | Tow-ti-ery-yoke     |
| Fox, white         | oot-le-a      | Man, white       | Kot-il-ery-yoke     |
| Fox, white         | Tah-o-wok     | Man, white       | La-lute-w-len       |
| Glove              | E-let         | Marmot           | Seek-cek            |
| Go                 | Owe-toh-to    | Marmot           | An-ah-ko            |
| Good               | Up-nuk-took   | Marmot           | Eh                  |
| Goose, black       | ook-uk-puk    | Mast             | Na-puk-yah          |
| Grass              | Wook          | Matches          | Nah-net             |
| Granulose          | Te-chin-na    | Me               | Chow-wung           |
| Gull               | U-ya          | Medicine         | At-ha-ga            |
| Gull, tern         | ah-uh-na      | Mine             | Pung-a              |
| Gun, of whales     | Sok-to        | Mine             | Hun-neen            |
| Gun                | Too-wu        | Mittens          | La-let              |
| Hair, human        | Noo-yuk       | Mittens          | Ah-ya-pouch-chow-wa |
| Hair, human        | Noo-ya        | Moon             | Ten-kuk             |
| Hair, human        | Ki-taw-a      | Moose            | Oop-ak              |
| Hair, animal       | Seew-kwok     | Mother           | Nag-                |
| Hammer             | Yup-pa        | Mother-in-       | Chow-wung, a nag    |
| Hand               | E-let         | Mountain         | oot-ak              |
| Hare               | ook-wa-oo     | Mountain sheep   | Kun-ha              |
| Hare               | ook-kaw-cho   | Mountain sheep   | Te-pu-let           |
| Hare               | ook-kaw-cho   | Mouth            | Kan-ka              |
| Hare               | Na-ah-let     | Mustache         | A-row-an            |
| Harpoon            | A-oo-let      | Nail             | To-ko-a             |
| Hatchet            | K-            | Naked            | Me-tum-eh-ah        |
| Hawk               | ook-let-ka    | Near             | Kun-a-too-uk        |
| Hawk               | ook-kaw-let   | Needle           | Se-kuk              |
| Heart              | Se-shah-ka    | Needle           | Se-kun              |
| Hermaphrodite      | Oh-ah-ka      | New              | No-tow-uk           |
| Herring            | Ki-oo-ya      | No               | A-hung-e-to         |
| Hill               | Nah-let       | No               | Wing-a              |
| Hill               | Tag-uk        | No, will not     | Wing-a-wung         |
| Hole               | ook-ke-mek-ka | Now              | Ke-hew-a            |
| House              | Mah-to-ha     | Now              | E-ute               |
| House, underground | Mung-let      | oar              | Ya-ah-kwa           |
| House, man's       | Kap-oo-ka     | Oil              | Me-oh-ak            |
| House, man's       | Nah-gum-e-ka  | Oil, seal        | Kah-uk              |
| House, and         | Chow-wung     | Oil, seal        | Ke-tig-a            |
| Ice                | Se-let        | Oil              | ook-took-wa         |
| Ice                | Se-wung-let   | open water, bog  | Mok-look            |
| Ice, walrus        | Too-oo-ka     | owl, snowy       | To-ka-let           |
| Ice, walrus        | Too-wung      | owl, snowy       | Hah-ya              |
| Ice, balls         | ook-kut-let   | Paddle           | An-oh-uk            |
| Jaw                | ook-ook       | Paint            | Ung-a-oh-uk         |
| Jelly fish         | To-let-ook    | Pantaloons       | Ke-ho-ka            |
| Jelly fish         | To-let-ook-ah | Pantaloons       | Kah-ow-ten          |
| Jelly fish         | King-oo       | Pantaloons, dret | Ip-pe-tah-wa        |
| Killer, orca       | Ne-gah-e      | Pick, or mattock | Seet-look           |
| Killer             | Shung-oh-     | Plenty           | Nim-ka-keen         |

|                |                  |                          |                  |
|----------------|------------------|--------------------------|------------------|
| Plenty         | Aba e lok'tuk    | Snow on ground           | An ne yak'a poon |
| Poke, seal bag | A wot'kuh wuk    | Snowing                  | Kong'ek          |
| Pot            | Koo ka'ne        | Snow-shoe                | Wool wuh'yak     |
| Pot            | Moo'ha           | Spear, whale             | Oo'a nok         |
| Ptarmigan      | Ti'let           | Spear, seal              | Tou'kwa          |
| Puffin         | Keeb ro'a        | Stand up                 | Muk koo'vuh      |
| Puffin         | Pe n'a           | Star                     | E la lu'ke tah   |
| Quick          | Shu kwil'nuk     | Star-fish                | Tao'ki ville     |
| Quick, very    | Shu ki loog'tin  | Star-fish                | Aa'ka vo che     |
| Rain           | Nip'chook        | Stocking                 | Pum'ya           |
| Raven          | Kwil'wit         | Stone tool               | Wil um'ok        |
| Raven          | Mut tuk'look     | Stoop                    | Goak'tah         |
| Ring, finger   | Long ko'holt     | Summer                   | Keek             |
| River          | Ni'wuk           | Sun                      | Shi kin'ya       |
| Rum, drink of  | A kwim'yak       | Teeth                    | Koo'tit          |
| Sable          | E la'yet         | Thimble                  | Tig'eh           |
| Sack           | Cho klo wok      | Thread                   | Kle'puk          |
| Sail           | Ting a lan uk ok | Tobacco                  | Chu lu'pa        |
| Salmon         | Kwad lu'pe       | To-morrow                | Oo got'tek       |
| Salmon         | Too in'a         | Tongue                   | Oo'leh           |
| Salmon-trout   | Ah'cho           | Turbot                   | Col au gu am     |
| Sand           | Kun'uk           | Turbot                   | Al ser g a'nek   |
| Saw            | Til be gew'na    | Vise                     | Pum chu'wuk      |
| Scissors       | Poo'look'tat     | Walrus                   | I wok            |
| Screw          | Tap'pe tok       | Walrus                   | Chit'chu         |
| Sculpin        | Ki na'ga         | Walrus skin              | Mun goo'na       |
| Sculpin        | Oo'rok           | Water                    | Im'uk            |
| Seal, common   | Al mu chuke      | Water, drink of          | Ne kwe'sheak     |
| Seal, common   | Nat'chok         | We                       | Oo mung'ham      |
| Seal, common   | Mam'lek          | Whale, bow-head          | Ok'kuh wuk       |
| Seal, common   | Nat'auk          | Whale, bow head          | Bo zruk          |
| Seal rope      | Tap kwa          | Whale, gray              | Ung to'hok       |
| Sexual         | O yo kwot'e ka   | Whale, fin back          | To po'hok        |
| Sexual         | Oo u look'in     | Whale, hump-back         | Tang wo'hok      |
| Ship           | Ung ye ok puk    | Whale, narwal            | Poo'jak          |
| Shirt          | Loo'luk          | Whale-bone               | Ook lung'a       |
| Shovel         | Poo'guoit        | Whale-bone               | Sho'kok          |
| Shrimp         | Kung a ta        | Whale flukes             | Kom'is tok       |
| Shrimp         | King'ak          | What do you wish         | Cha lu'ga la     |
| Shrimp         | Ok shuk'ee ruk   | What do you wish         | Pe ra kot'ka     |
| Shut (door)    | Tel li pat'ka    | Wife                     | A lik'ha         |
| Shut (door)    | Ma kot'u         | Wind                     | An o'ka          |
| Sing           | Ia lug'era       | Winter                   | Sho'ka           |
| Sink           | Ki lu goo ta     | Wish                     | A lu ga nu       |
| Sister         | Ni yag           | Wolf                     | Kun la'ga        |
| Sit down       | Ko a ko'a        | Wolf                     | Oo koo'a         |
| Sit down       | Ok'o noke        | Wolverine                | Kap'ee           |
| Skin           | Ah ne we jek     | Woman                    | Ok'an ok         |
| Sled           | Kom mi'a         | Women                    | Now'skat         |
| Sled           | Kom me ke        | Woodcock (golden plover) | Tou'lik          |
| Sled           | Oo go'ro         | Wrestle                  | Tou'a waik       |
| Sleep          | Ka rok           | You                      | Shu'pa           |
| Small          | Pi lo kin        | You                      | Hun              |
| Smell          | Nih hah          | Youre                    | Hun'yan          |
| Smoke          | Poo'yok          |                          |                  |

ESKIMO ENGLISH VOCABULARY.

|               |               |                      |              |
|---------------|---------------|----------------------|--------------|
| A hang'e ta   | Consumed      | Ah me ta             | Ermine       |
| Aba e lok'tuk | Plenty        | Ah ne we we jek      | Skin         |
| Aba'look      | Arctic Ocean  | Ah tok'a             | Father       |
| A hang'e to   | No            | Ah vak look          | Clear        |
| A gab tik     | To-morrow     | Ah ya polch chung na | Mittens      |
| Ah'cho        | Salmon trout  | A kwim'yak           | Drink of rum |
| Ah ha'ga      | Melt me       | Al mu'chuke          | Seal         |
| Ah klo'ke     | Second finger | Al serg a'nek        | Turbot       |
| Ah me kin ko  | Ermine        | A lu'ga me           | Want         |



|                |                  |               |                |
|----------------|------------------|---------------|----------------|
| A-luk-to       | Third finger     | Ke-nook'a     | Face           |
| A-moo-at       | Mustache         | Ke-tig'a      | Oil skin       |
| A-mo-uk-a-poon | Snow on ground   | Ken'yo        | Badger         |
| An-uk-a        | Wind             | Kig-meen'mook | Pot            |
| An-u-wok       | Padicle          | Kig'mok       | Dog            |
| At-uk-a        | Marmot           | Kil-la-luk    | Cloudy         |
| As-mu          | Enough           | Ki-lu-goo'too | Sink           |
| As-ka-yo-ho    | Starfish         | Kin'a-ga      | Sculpin        |
| At-k-ne        | Dog              | King'ik       | Diver          |
| At-kook        | Coat             | King'oo       | Jelly fish     |
| A-wot-k-i-wuk  | Seal poke        | King'yuk      | Shrimp         |
| A-u-wuk        | Harpoon          | Kit-swen      | Indian hair    |
| Bee-ne-uk-uk   | Deer boots       | K'u           | Hatchet        |
| Bee-tus        | Bow head whale   | Kle-puk       | Thread         |
| Cha-u-ga-la    | What do you wish | Ko-a-ko-a     | Sit down       |
| Cha-lu-pa      | Tobacco          | Kob-bo-ra     | Herring        |
| Chit-chu       | Walrus           | Kob-ro'a      | Puffin         |
| Chit-kio-uk    | Sock             | Koh-u-ma      | Torn           |
| Chit-nek       | Deer horns       | Kol-up-se-kan | Fancy boots    |
| Chow-wa        | Knife            | Kol-hun       | Woman          |
| Chut-lut       | Curlew           | Kol-au-gwan   | Turbot         |
| Chu-ne         | White fox        | Kom-a-tuk     | Whale dukes    |
| Fat            | Hand glove       | Kom-me-a      | Sled           |
| Fa-luk-ko-ta   | Star             | Kom-me-ke     | Sled           |
| Fa-yet         | Saule            | Kong-wok      | Widgeon        |
| El             | Marmot           | Kon-ik        | Snowing        |
| Eren           | Coat             | Koo-ka-ne     | Pot            |
| E-ta-nek       | Idle             | Koom-luk      | Thumb          |
| E-ta-ge        | Feet             | Koom-nik      | Fence          |
| Fa-ko          | Fourth finger    | Koot-tit      | Teeth          |
| Fa             | Five             | Kou-wa-a      | Cotton         |
| E-ko           | Now              | Ko-rung-a     | Deer           |
| Gook-a         | Stoop            | Kot-fo-ry-oke | White man      |
| Hap-pa         | White owl        | Kot-ka        | White fox      |
| H-tung-a       | Cold             | Kot-pou-n     | Door           |
| H-ko           | Badger           | Kow-a-ruk     | Breeze         |
| Han            | You              | Ko-ye-uk      | Water boots    |
| Han-ut         | Yours            | Kuh-ya        | Lip            |
| I-wat          | Red fox          | Kun-at-oo-uk  | Near           |
| I-ko-ko        | He is not        | Kung-ara      | Shrimp         |
| I-pu-ut        | Cliff            | Kun-laga      | Wool           |
| I-ma           | Water            | Kun-ya        | Sand           |
| I-ko-ko        | Good             | Kwa-chi       | Feder duck     |
| I-pu-ko-a-wa   | Panties          | Kw-l-wat      | Haven          |
| I-ko-ko        | Leg              | Kw-ut         | Fight          |
| I-wok          | Waist            | K'ik          | Covered canoe  |
| Ka-lu-ko-a     | Arctic           | La-leet       | Mitten         |
| Ka-lu-ko-a     | Red fox          | La-lu-a-ta    | Sing           |
| Ka-lu-ko-a     | Red              | La-lu-wa-lu   | White man      |
| Ka-lu-ko-a     | Black bear       | Long-ko-hut   | Finger ring    |
| Ka-lu-ko-a     | Arctic           | Luk-luk       | Over shirt     |
| Ka-lu-ko-a     | Arctic           | Luk-luk       | Brant          |
| Ka-lu-ko-a     | Arctic           | Luk-luk-puk   | Grass          |
| Ka-lu-ko-a     | Arctic           | Ma-kot-u      | Shut door      |
| Ka-lu-ko-a     | Arctic           | Ma-muk        | Seal           |
| Ka-lu-ko-a     | Arctic           | Ma-muk        | Breasts        |
| Ka-lu-ko-a     | Arctic           | Ma-muk        | Eggs           |
| Ka-lu-ko-a     | Arctic           | Ma-muk        | Fish           |
| Ka-lu-ko-a     | Arctic           | Ma-muk        | Seal           |
| Ka-lu-ko-a     | Arctic           | Ma-muk        | Animal hair    |
| Ka-lu-ko-a     | Arctic           | Ma-muk        | Naked          |
| Ka-lu-ko-a     | Arctic           | Ma-muk        | Big open water |
| Ka-lu-ko-a     | Arctic           | Ma-muk        | Pot            |
| Ka-lu-ko-a     | Arctic           | Ma-muk        | Box            |
| Ka-lu-ko-a     | Arctic           | Ma-muk        | Breasts        |
| Ka-lu-ko-a     | Arctic           | Ma-muk        | Walrus skin    |

|      |                    |                   |                     |
|------|--------------------|-------------------|---------------------|
| i    | House              | Ow e tok'o        | Go                  |
| k    | Go to bed          | Owk               | Blood               |
|      | Whale meat         | O yok wot'eka     | Inter-course        |
| ok   | Raven              | Pah kin ok        | Brown bear          |
|      | Mother             | Pa'recht          | Whale line          |
|      | Smell              | Pe lek'it         | Boots               |
|      | Matches            | Pe lo'kin         | Small               |
|      | Hare               | Pe ni'a           | Puffin              |
|      | Land otter         | Pe rak ot'ku      | What do you want    |
|      | White bear         | Pil' wint in      | Iron                |
|      | White bear         | Poo'goodt         | Shovel              |
|      | Lake               | Poo'jak           | Narwal              |
| ik   | Mast               | Poo'jook' tat     | Scissors            |
| ok   | Crazy              | Poo'noon          | Clam                |
|      | Seal               | Poo'yok           | Smoke               |
|      | Curlew             | Pum chu'wuk       | Vise                |
|      | Seal               | Pum'ye            | Stocking            |
|      | Eat                | Pung'a            | Mine                |
|      | Whale killer       | Rok'ua            | Fly                 |
| ok   | Drink of water     | Room'ka           | White bear          |
| in   | Big                | Sang sek'a hoy ik | Duck                |
|      | Crab               | Seek'eeh          | Marmot              |
|      | Drawers            | Seet'look         | Mattock             |
| k    | Know               | Se'guh            | Ear                 |
| ok   | Badger             | Se'koon           | Needle              |
| en   | Plenty             | Se'ku             | Ice                 |
| in   | Hungry             | Se'kuh            | Needle              |
|      | Rain               | Se u'auk          | Box                 |
|      | Mountain           | Sha lig a not     | What do you wish    |
|      | Hill               | Shi kin'ya        | Sun                 |
|      | River              | Sho'ke            | Winter              |
|      | Sister             | Sho'kok           | Whalebone           |
|      | Human hair         | Sho'kwa           | Crane               |
|      | Human hair         | Sho ki loog'tin   | Very quick          |
|      | Woman              | Shu kwil'nut      | Quick               |
|      | Badger             | Shung ow'ro       | Head                |
| pe   | Go to bed          | Shung sho         | Whale killer        |
| uk   | Stand              | Shu'pi            | You                 |
| a    | Button             | Sing noh'a luk    | Kiss                |
|      | Under ground house | Snuh'ok           | Boy                 |
|      | New                | So ko'ra          | Whale gum           |
|      | Woman              | Soo nek           | Comb                |
|      | Bow head whale     | Sow woo'yuk       | Drum                |
| k    | Big duck           | Stoke             | Finger nail         |
|      | Crazy              | Suk ala'yuke      | Bad man             |
|      | Sit down           | Suk'a luk         | Bad                 |
|      | Crow-bill duck     | Tah'owok          | White fox           |
| u    | Hermaphrodite      | Tak nil'er ge     | Black               |
|      | Big                | Tal let           | Ptarmigan           |
|      | Whale spear        | Tal no'whoh       | Baby                |
| u    | Hate               | Ta pal'let        | Linx                |
| luk  | Hole               | Tap'che           | Belt                |
|      | Whalebone          | Tap'kwok          | Cable               |
|      | Wolt               | Tao pe'tok        | Screw               |
|      | Fire               | Tas luk           | Arm                 |
| s'pe | Salmon             | Te chim'na        | Grindstone          |
| k    | Hare               | Ted lo pat'ka     | Shut door           |
|      | Tonzo              | Ten keh           | Moon                |
|      | Old                | Te pal'et         | Mountain sheep      |
| um   | We                 | Te po'uk          | Fin-back whale      |
|      | Moss               | Tig'ch            | forefinger, thimble |
| u    | Inter-course       | Tig'uk            | Hit                 |
|      | Anchor             | Til he gew na     | A saw               |
|      | Husband            | Ting a lan uk'ok  | Nail                |
|      | Lamp               | Tis ke ville      | Star fish           |
|      | Sled               | To a waik         | Wrestle             |



|             |                 |                |             |
|-------------|-----------------|----------------|-------------|
| Totruk      | Eider duck      | Tung yo'a      | Bracelet    |
| Tok'a lo    | Small owl       | Tos luk'tuk    | Deaf        |
| Tok'a nio   | Sock            | U'a yeh        | Gull        |
| Tok'a o'a   | Hawk            | Uk shuk'se ruk | Shrimp      |
| Tok'a o'a   | Seal            | U'ik'a         | Wife        |
| Tok'a o'a   | Deer            | Ung'a so shok  | Paint       |
| Tok'a o'a   | Goat            | Ung to hok     | Gray whale  |
| Tosuk'a     | Squirrel        | Ung yo ok yuk  | Ship        |
| Tosuk'a o'a | Walrus tusk     | Ung'yet        | Boat        |
| Tosuk'a o'a | Saw post        | U'pu tuk tuk   | Coast       |
| Tosuk'a o'a | Green parrot    | U'puk to t     | Ball, quail |
| Tosuk'a o'a | Deer            | U'w'u wa       | Loon        |
| Tosuk'a o'a | Eider duck      | Wen'ie         | Eagle       |
| Tosuk'a o'a | Goose           | Wing yo        | Certainly   |
| Tosuk'a o'a | Deer            | Wing'oi        | Stone tool  |
| Tosuk'a o'a | Finished        | Wing'a         | No          |
| Tosuk'a o'a | Button          | Wing'a wing    | Will not    |
| Tosuk'a o'a | Walrus tusk     | Wool wuk yuk   | Snow shoe   |
| Tosuk'a o'a | Goat            | Wot'le a       | Knife       |
| Tosuk'a o'a | Jeil'neh        | Ya lo swa      | Out         |
| Tosuk'a o'a | Jeil'neh        | Yap'ska        | Cartridge   |
| Tosuk'a o'a | Sag're          | Yok            | Man         |
| Tosuk'a o'a | White fox       | Yok'tuh        | Fathom      |
| Tosuk'a o'a | Crate           | Yoo'pe         | Brother     |
| Tosuk'a o'a | Hump back whale | Yup'pa         | Summer      |

*From*

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THE  
TEACHING AND HISTORY  
OF  
MATHEMATICS  
IN  
THE UNITED STATES

BY

FLORIAN CAJORI, M. S. ( University of Wisconsin )

**FORMERLY PROFESSOR OF APPLIED MATHEMATICS IN THE TULANE UNIVERSITY OF  
LOUISIANA, NOW PROFESSOR OF PHYSICS IN COLORADO COLLEGE.**

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WASHINGTON  
GOVERNMENT PRINTING OFFICE  
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DEPARTMENT OF THE INTERIOR,  
BUREAU OF EDUCATION,  
*Washington, D. C., February 19, 1889.*

SIR: I have the honor to transmit herewith the manuscript of a History of Mathematical Teaching in the United States, by Prof. Florian Cajori, a graduate of the University of Wisconsin, student at Johns Hopkins University, and recently professor of applied mathematics in Tulane University of Louisiana—a work prepared with your approval, under the direction of this Office.

The table of contents indicates the wide scope of the work and the variety of subjects treated, but scarcely more than suggests the painstaking labor involved in its preparation. Professor Cajori's researches have extended through several years, and have been pursued in the libraries of Baltimore, Philadelphia, and Washington. He has personally conducted a large correspondence with alumni, and past and present instructors in the higher educational institutions, and has been aided by 1,000 circulars of inquiry sent from this Office relating to the present condition of mathematical teaching in schools of all grades.

I am convinced that this monograph will prove of great value to all teachers and students of mathematics, and will be not without interest to any person engaged in the work of education. I therefore respectfully recommend its publication.

I have the honor to be, sir, very respectfully, your obedient servant,  
N. H. B. DAWSON,  
*Commissioner.*

Hon. WM. F. VILAS,  
*Secretary of the Interior, Washington, D. C.*

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3

DEPARTMENT OF THE INTERIOR,  
*Washington, D. C., April 11, 1889.*

**The COMMISSIONER OF EDUCATION:**

**SIR:** I acknowledge the receipt of your letter of February 19, 1889, in which you recommend the publication of a monograph, a history of mathematical teaching in the United States.

Authority is hereby given for the publication of the monograph, provided there are funds in sufficient amount available for such purpose.

Very respectfully,

**JOHN W. NOBLE,**  
*Secretary.*

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# THE TEACHING AND HISTORY OF MATHEMATICS IN THE UNITED STATES.

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## I.

### COLONIAL TIMES.

#### ELEMENTARY SCHOOLS.

On the study of mathematics in elementary schools of the American colonies but little can be said. In early colonial days schools did not exist except in towns and in the more densely settled districts; and even where schools were kept, the study of mathematics was often not pursued at all, or consisted simply in learning to count and to perform the fundamental operations with integral numbers. Thus, in **Hampstead, N. H.**, in 1750, it was voted "to hire a school-master for six months in ye summer season to teach ye children to read and write." Arithmetic had not yet been introduced there. As late as the beginning of this century there were schools in country districts in which arithmetic was not taught at all. **Bronson Alcott**, the prominent educator, born in **Massachusetts** in 1799, in describing the schools of his boyhood, says: "Until within a few years no studies have been permitted in the day school but spelling, reading, and writing. Arithmetic was taught by a few instructors one or two evenings in a week. But in spite of the most determined opposition arithmetic is now permitted in the day school." This was in **Massachusetts** at the beginning of this century.

In secondary schools, "ciphering" was taught during colonial times, which consisted generally in drilling students in the manipulation of integral numbers. He was an exceptional teacher who possessed a fair knowledge of "fractions" and the "rule of three," and if some pupil of rare genius managed to master fractions, or even pass beyond the "rule of three," then he was judged a finished mathematician.

The best teachers of those days were college students or college graduates who engaged in teaching as a stepping-stone to something better. An example of this class of teachers was **John Adams**, afterwards President of the United States. Immediately after graduating at **Harvard** and before entering upon the study of law, he presided, for a few years, over the grammar school at **Worcester**. From a letter

written by him at Worcester, September 2, 1755, we clip the following description of the teacher's daily work:

As soon as the monarch ends his throne, the pedagogue mounts his awful *great chair*, the pupils straight posture through his whole empire. His obsequious subjects come to his imperial mandates with cheerfulness, and think it their high happiness to be employed in the service of the emperor. Sometimes paper, sometimes his pen-knife, now arithmetic, now a ferule, then ABC, then scolding, then flattering, now laughing, calls for the pedagogue's attention.

School appliances in those days were wholly wanting (excepting the ferule and birch rods). Slates were entirely unknown for school use until some years after the Revolution; blackboards were introduced much later. Paper was costly in colonial days, and we are told that birch bark was sometimes used in schools in teaching children to write and figure. Thirty-six years ago a writer in one of our magazines\* wrote as follows:

"There are probably men now living who learned to write on birch and birch bark, with ink made out of maple bark and copperas." But more generally "ciphering" was done on paper. Dr. L. P. Brockett says that on account of its dearth and scarcity, "the backs of old letters, the blank leaves of ledgers and day-books, and even the primer books were eagerly made use of by the young arithmeticians."

Since few or none of the pupils had text-books it became necessary for the teacher to dictate the "sums." As in the colleges of that time, so in the primary schools, *manuscript books* were used whenever printed ones were not accessible. To advanced boys the teacher would give exercises from his manuscript or "ciphering book," in which the problems and their solutions had been previously recorded. "With a book of his own, the pupil solved the problems contained in it in their proper order, working hard or taking it easy as pleased him, showed the solution to the teacher, and if found correct generally copied them in a blank-book supplied for the purpose. . . . Some of these old manuscript ciphering books, the last, one may suppose, having come down through several generations, are still preserved among old family records, bearing testimony to the hard writing and the careful copying, if not to the arduousness and labor of those who prepared them. When a pupil was required to solve a problem he called recourse to the master, who solved it for him, and the pupils copied it. . . . It is reported that a dozen or twenty pupils stood around the master's desk waiting with . . .

the master's permission. "In the venerable classes in arithmetic, no explanation of the principles of the art, no demonstrations of principles, no definitions, no definitions of terms. The problems were solved, the answers were given, and the work was considered complete. But the pupils acquired a good knowledge of arithmetic under the guidance of the master, and this result was clearly due rather to the nature of the work than to wise direction."<sup>1</sup> Those

\* *Magazine of American Literature*, Boston, 1864, Vol. II, p. 452.

<sup>1</sup> *Journal of the American Historical Association*, by James Pyle Wickersham, p. 205.

teachers who were the fortunate possessors of a printed arithmetic used it as a guide in place of the old "ciphering-book."

In the early schools, arithmetic was hardly ever taught to girls. Rev. William Woodbridge says that in Connecticut, just before the Revolution, he has "known boys that could do something in the first four rules of arithmetic. Girls were never taught it."<sup>1</sup> In the two "charity schools" in Philadelphia, which before the Revolution were the most celebrated schools in Pennsylvania, boys were taught reading, writing, arithmetic; girls, reading, writing, sewing. Thus, sewing was made to take the place of arithmetic. Warren Burton, in his book entitled, "The District School as it was, by one who went to it," says that, among girls, arithmetic was neglected. The female portion "generally expected to obtain husbands to perform whatever arithmetical operations they might need beyond the counting of fingers." Occasionally women were employed in summer schools as teachers, but they did not teach arithmetic. A school-mistress "would as soon have expected to teach the Arabic language as the numerical science."

The early school-books in New England and in all other English settlements were much the same as those of Old England. John Locke, in his *Thoughts concerning Education* (1690), says that the method of teaching children to read in England has been to adhere to "the ordinary road of horn book, primer, psalter, testament, and bible." This same road was followed in New England. We are told that books of this kind were sold to the people by John Pynchon, of Springfield, from 1656 to 1672 and after.<sup>2</sup> Regular arithmetics were a great rarity in this country in the seventeenth century. The horn-book has been raised by some to the dignified name of a "primer" for teaching reading and imparting religious instruction. If this be permissible, then why should we not also speak of it as an *arithmetical* primer? For, what was the horn-book? It consisted of one sheet of paper about the size of an ordinary primer, containing a cross (called "criss-cross"), the alphabet in large and small letters, followed by a small regiment of monosyllables; then came a form of exorcism and the Lord's Prayer, and, finally, the *Roman numerals*. The leaf was mounted on wood, and protected with transparent horn,

"To save them from wet the letters fair."

It is on the strength of the Roman numerals that we venture to propose the horn-book as a candidate for the honor of being the first mathematical primer used in this country. Horn-books were quite common in England and in the British colonies in America down to the time of George II. They disappeared entirely in this country before the Revolution. In early days the common term of reproach to a ignorant was "he does not know his horn-book." This is equivalent to the more modern saying, "he does not know his letters."

<sup>1</sup> *Reminiscences of the Revolution in Connecticut*, by Rev. Wm. Woodbridge, p. 137.

<sup>2</sup> *Bartram's Journal of Travels*, Vol. II, 1711.

George Fox, the founder of the Society of Friends, published in 1674, in England, a primer or spelling book, which was republished at Philadelphia in 1701, at Boston in 1743, and at Newport, R. I., in 1769.\* Wickersham describes this little book as containing the alphabet, lessons in spelling and reading, explanations of scripture names, *Roman numerals*, *lessons in the fundamental rules of arithmetic and weights and measures*, a perpetual almanac, and catechism with the doctrine of the Friends. It may be imagined that a mere primer, covering such a wide range of subjects, could contain only a very few of the simplest rudiments of a subject like arithmetic. Fox's book was used little outside of the Society of Friends.

Wickersham (p. 201) speaks of another book which is of interest as illustrating the book-making of those old times. It is entitled, "The American Instructor, or Young Man's Best Companion, containing Spelling, Reading, Writing, *Arithmetic, in an Easier Way than any yet Published*, and how to Qualify any Person for Business without the Help of a Master." It was written by George Fisher, and printed in Philadelphia, in 1748, by Franklin and Hall. This work never attained any popularity.

Dr. Brackett says that in New Jersey and, perhaps, also in Virginia, a book resembling the "New England Primer," but as intensely Royalist and High Church in religion as the New England Primer was Puritan and Independent, was in use in schools. It was called "A Guide for the Child and Youth, in two parts; the First for Children. • • • the second for Youth: Teaching to write, *cast accounts* and read more perfectly; with several other varieties, both pleasant and profitable. By F. H. M. A., Teacher of a Private School, London, 1762." It does not appear that this book was reprinted here.

Wickersham gives another book of similar stamp but of much later date. "Lehr- und Hocker's Rechenbüchlein" was published at Ephrata, Pennsylvania, in 1786. The Ephrata publication is an exceedingly curious compound of religious exercises and exercises in arithmetic. The Lord's Prayer, hymns, and texts of scripture, are strangely intermingled with problems and calculations in the simpler parts of arithmetic.

One of the earliest purely arithmetical books used in this country was the arithmetic of Thomas H. Hill. It may possibly have fallen into the hands of some of our teachers as Fiske Cheever, "the father of Connecticut's public schools," the promoter and patriarch of elementary education in New England.<sup>77</sup> The history of schools at Salem, Mass., would seem to point to one of our earliest arithmetics as James Hoslder's.<sup>78</sup>

\* See *Wickersham's History of Education*, by Charles F. Wickersham, p. 191.

<sup>77</sup> *Wickersham's History of Education*, p. 191. He was a teacher for twenty years, he died in 1785 at the age of eighty, and, according to Fiske, he was held in an unusual degree to the very last.

Hodder was a famous English teacher of the seventeenth century. Later writers have borrowed largely from his arithmetic of which the first edition, entitled "Hodder's Arithmetick, or that necessary art made most easy," appeared in London in 1661. An American edition from the twenty-fifth English edition was published in Boston in 1719. This is the first purely arithmetical book known to have been printed in this country.

In New York the Dutch teachers of the seventeenth century imported from Holland an arithmetic called the "Coffer Konst," written by Pieter Venema, a Dutch school-master, who died about 1612. So popular was the book that an English translation of it was published in New York in 1730. Venema's appeared to be the second oldest arithmetic printed in America.

An English work almost as old as Hodder's, which met with a limited circulation in this country, is Cocker's Arithmetic. The first edition appeared in England after the death of Cocker, in 1677. According to its title page it was "perused and published by John Hawkins, \* \* \* by the author's correct copy." De Morgan is perfectly satisfied that "Cocker's Arithmetic was a forgery of Hawkins's, with some assistance, it may be, from Cocker's papers." Regarding the book itself, De Morgan says:\* "Cocker's Arithmetic was the first which entirely excluded all demonstration and reasoning, and confined itself to commercial questions only. This was the secret of its extensive circulation. There is no need of describing it; for so closely have nine out of ten of the subsequent school treatises been modelled upon it, that a large proportion of our readers would be able immediately to turn to any rule in Cocker, and to guess pretty nearly what they would find there. Every method since his time has been "according to Cocker." This book was found here and there in the colonies at an early date. Thus we read in Benjamin Franklin's Autobiography that (at about the age of sixteen; i. e., about 1722) "having one day been put to the blush for my ignorance in the art of calculation which I had twice failed to learn while at school, I took Cocker's treatise on arithmetic and went through it by myself with the utmost ease." An American edition of the work appeared in Philadelphia in 1779. It contains the rude portrait of the author, "which might be taken for a caricature," and also the following poetical recommendation:

Ingenious Cocker, now to Rest thou 'rt gone,  
No Art can show thee folly, but thine own;  
Thy rare Arithmetick alone can show  
Th' vast Thanks we for thy labours owe.

Wickersham† mentions Daniel Fenning's *Der Geschwinde Rechner* as having been published by Sower in 1774.

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\* Article, "Cocker," Penny Cyclopædia.

† History of Education in Pennsylvania, p. 200.



**New London 1797, and Albany 1824.** At the beginning of the Revolution this was the most popular arithmetic, and it continued in use long after

We have now enumerated all the arithmetics which were used to our knowledge in the American colonies. It may be instructive to give the last book which we have mentioned a closer examination; for Dilworth's School-master's Assistant was the most noted arithmetic of its time. As an arithmetician Dilworth belonged to the school founded by Cocker, which scrupulously excluded all demonstration and reasoning. The School-master's Assistant gives all rules and definitions in the form of questions and answers. Let us turn to page 44 of the twenty-second London edition, 1784, and examine his mode of explaining proportion, or, as the subject was then called, the "Rule of Three."

#### OF THE SINGLE RULE OF THREE.

- Q.** How many Parts are there in the Rule of Three ?  
**A.** Two: Single or Simple, and Double or Compound.  
**Q.** By what is the single Rule of Three known ?  
**A.** By three Terms, which are always given in the Question, to find a fourth.  
**Q.** Are any of the terms given to be reduced from one Denomination to another ?  
**A.** If any of the given terms be of several denominations, they must be reduced into the lowest Denomination mentioned.  
**Q.** What do you observe concerning the first and third Terms ?  
**A.** They must be of the same Name and Kind.  
**Q.** What do you observe concerning the fourth Term ?  
**A.** It must be of the same Name and Kind as the second.  
**Q.** What do you observe of the three given Terms taken together ?  
**A.** That the two first are a Supposition, the last is a Demand.  
**Q.** How is the third Term known ?  
**A.** It is known by these, or the like Words, *What cost? How many? How much?*  
**Q.** How many Sorts of Proportion are there ?  
**A.** Two: Direct and Inverse.

And so on. We have quoted enough to give an idea of the book. It is not easy to see how a pupil beginning the subject of proportion could get clear notions from reading the above. Nor can we see how a boy who had never before heard of fractions could get any idea whatever of a fraction from Dilworth's definition, which is (p. 111): A fraction "is a broken number and signifies the part or parts of a whole number."

A closer examination of this arithmetic discloses many other strange things. It consists really of three parts, more or less complete in themselves, namely: Part I, on whole numbers; Part II, on vulgar fractions; Part III, on decimal fractions. In Part I, the student is carried through the elementary rules, and through interest, fellowship, exchange, double rule of three, alligation, single and double position, geometrical progression, and permutations. He is carried through all these without having as yet even heard of fractions. The advanced and comparatively unimportant subjects, such as alligation and progressions, are made



to precede so important and fundamental a subject as fractions. The teaching of decimal fractions *after* interest is illogical, to say the least. In Part II, after fractions have been explained, the rule of three is taken up a second time; and in Part III, under decimal fractions, it is resumed a third time. Thus this rule is explained three times: the first time with whole numbers, the second time with common fractions, the third time with decimal fractions—thus leaving the impression that the rule is different in each one of the three cases.

The whole book is nothing but a Pandora's box of disconnected rules. It appeals to memory exclusively and completely ignores the existence of reasoning powers in the mind of the learner. Noticeable is the fact that in the treatment of common fractions, the process of "cancellation," which may be made to shorten operations so much, is not even mentioned. The book abounds in unnecessary and perplexing technical terms, such as "practice," "conjoined proportion," "alligation medial," "alligation alternate," "comparative arithmetic," "biquadrate roots," "sursolids," "square cubes," "second sursolids," "biquadrates squared," "third sursolids," and "square cubes squared." Under the head of duodecimals are given rules like these: "Feet multiplied by feet give feet;" "feet multiplied by inches give inches," etc. These rules, taken literally, are absurd. We can no more multiply feet by feet than we can multiply umbrellas by umbrellas. These rules are in opposition to the fundamental ideas of multiplication in arithmetic. A concrete number cannot be multiplied by a concrete number. It seems strange that so gross an error should not have been corrected in later editions of the book; but still more strange is the fact that nearly all arithmetics down to the present day should have persisted in making this mistake.

As one source of the confusion of ideas to which it gives rise, I quote the following from an article "Early School Days" in *Indiana*, contributed by James C. Hobbs.\* A law had just been passed requiring that common transactions should be conducted by three county exchanges instead of the twelve hundred stores, as had been the practice before, and "all that for a time," says Hobbs, "my first experience under the new system of exchange, and the first of my first examination was, 'What is the product of 25 cents by 25 cent?' . . . We were puzzled, and that is perpetrate now. We had only Pike's Arithmetic, and the tables and the rules. These were consulted and the result was, 'How could 1 cent the product of 25 cents by 25 cent?' . . . I could not find out the formula in the book. The explanation of the error was not given at once. I thought just as he did, and it was not until some time later that we discovered the mistake. He said that he was sure I was qualified to find out the error. I did not see it, but he was given me."

\*The *Indiana*, 1906, by James C. Hobbs, 1:756.

We have spoken of Dilworth's School-master's Assistant at some length, because from it we can see what sort of arithmetics we inherited from the English. All arithmetics of that time were much alike. The criticisms upon one will therefore apply to all.

Before proceeding to another subject we shall examine briefly the "Short Collection of Pleasant and Diverting Questions" in Dilworth. We shall meet there with a company of familiar friends. Who has not heard of the farmer, who, having a fox, a goose, and a peck of corn, and wishing to cross a river, but being able to carry but one at a time, was confounded as to how he should carry them across so that the fox should not devour the goose, nor the goose the corn? Who has not heard of the perplexing problem of how three jealous husbands with their wives may cross a river in a boat holding only two, so that none of the three wives shall be found in company of one or two men, unless her husband be present? Many of us, no doubt, have also been asked to place the nine digits in a quadrangular form in such a way that any three figures in a line may make just 15? When these pleasing problems were first proposed to us, they came like the morning breeze, with exhilarating freshness. We little suspected that these apparently new-born creatures of fancy were in reality of considerable antiquity; that they were found in an arithmetic used in this country one hundred years ago. Still greater is our surprise when we learn that at the time they were published in Dilworth's School-master's Assistant some of these questions for amusement had already seen as many as one thousand birthdays. The oldest record bearing upon this subject is found in a manuscript entitled *Propositiones ad acuendos iuvenes*. The authorship of this paper has been generally attributed to Alcuin, whose years of greatest activity were spent in France, in the court of the great Charlemagne, and who was one of the most learned scholars and celebrated teachers of the eighth century. The MS. attributed to him contains the puzzle about the wolf, goat, and cabbage, which in the modern version is known as the "fox, goose, and peck of corn" puzzle.

In a MS. coming from the thirteenth century, two learned German youths, named Firri and Tyrri, are made to propose to each other problems and puzzles. Firri takes among others the hard nut of Alcuin about the wolf, goat, and cabbage head, and lays it before Tyrri in the modified and improved version of the three wives and the three jealous husbands. This same document contains also the following: "Firri says: There were three brothers in Cologne, having nine vessels of wine. The first vessel contained 1 quart (amam), the second 2, the third 3, the fourth 4, the fifth 5, the sixth 6, the seventh 7, the eighth 8, the ninth 9. Divide the wine equally among the three brothers, without mixing the contents of the vessels."

This problem admits of more than one solution, and is closely related to the last problem we quoted from Dilworth's collection. It is of spe-

cial interest, since it gives rise to the following magic square, in which any three figures in a straight line have 15 for their sum.

|   |   |   |
|---|---|---|
| 2 | 7 | 6 |
| 9 | 5 | 1 |
| 4 | 3 | 8 |

The history of magic squares is a rich field for investigation. The Germans were by no means the originators of them. This honor must be given to the Brahmins in India. Later on the study of these curious problems was zealously pursued by the Arabs, who transmitted the fruits of their study to the Europeans.

Had we the time, we would attempt to trace the history of some other familiar puzzles. But enough has been said to show that many of them possess great antiquity. Nevertheless, when they were first proposed to us, they betrayed no signs of old age. May they continue perpetually in their youth, and may they delight the minds of men for numberless centuries to come!

#### COLLEGES.

##### HARVARD COLLEGE.

As early as 1636 the people of Massachusetts stamped their approval upon the cause of higher education by the founding of Harvard College. The nature of the early instruction given at this oldest of American colleges is of special interest to us. The earliest record bearing on the history of the rise of mathematical studies at Harvard is a tract entitled, "New England's First Fruits." It was originally published in 1643, or five years after the college had opened, and contained the curriculum of studies then pursued. Whoever expects to find in it an extended course of mathematical studies resembling that in our colleges of to-day will be much disappointed.

In the first place, a student applying for admission to Harvard in 1643 was not confronted and embarrassed by any entrance examinations in mathematics. The main requirement for admission was Latin. Contrary to the practice of to-day, Latin was then taught as a spoken language. "So much Latin as was sufficient to understand Tully, or any like classical author, and to make and speak true Latin in prose or verse, and so much Greek as was included in declining perfectly the paradigms of the Greek nouns and verbs," were the necessary requisites for admission, but in mathematics applicants were *required* to know not even the multiplication table.

When we come to examine the college course, which extended originally through three years, we meet with other surprises. Boys did

not receive that thorough "grinding" in the elements during the first years of college that they do now; on the contrary, no mathematics at all was taught except during the last year. The mathematical course began in the Senior year, and consisted of arithmetic and geometry during the first three-quarters of the year, and astronomy during the last quarter. Algebra was then an unknown science in the New World. It is interesting to notice that, in this original curriculum, the attention of each class was concentrated for a whole day upon only one or two subjects. Thus, Mondays and Tuesdays were devoted by the third year students exclusively to mathematics or astronomy, Wednesdays to Greek, Thursdays to "Eastern tongues," and so on. The importance attached to mathematical studies, as compared with other branches of discipline, may be inferred from the fact that ten hours per week were devoted to philosophy, seven to Greek, six to Rhetoric, four to Oriental languages, but only two to mathematics. According to these figures, Oriental languages were considered twice as important as mathematics. But we must remember that this course was laid out for students who were supposed to choose the clerical profession. For that reason, philosophical, linguistic, and theological studies were allowed to monopolize nearly the whole time, while mathematics was excluded almost entirely.

In what precedes we have measured the college work done in 1643 by the standards of 1889. Let us now compare it with the contemporaneous work in English universities. We may here premise that in the middle of the seventeenth century rapid progress was made in the mathematical sciences. In 1643, Galileo had just passed away; Cavalieri, Torricelli, Pascal, Fermat, Roberval, and Descartes were at the zenith of their scientific activity; John Wallis was a young man of twenty-seven, Isaac Barrow a youth of thirteen, while Isaac Newton was an infant feeding from his mother's breast. Though much original work was being done, especially by French and Italian mathematicians, the enthusiasm for mathematical study had hardly reached the universities. Some idea of the state of mathematics at Cambridge, England, previous to the appearance of Newton, may be gathered from a discourse by Isaac Barrow, delivered in Latin, probably in 1654, or eighteen years after the founding of Harvard College. In it occurs the following passage: "The once horrid names of Euclid, Archimedes, Ptolemy, and Diophantus, many of us no longer hear with trembling ears. Why should I mention the fact that by the aid of arithmetic, we have now learned, with easy and instantaneous work, to compute accurately the number of the very sands (themselves). \* \* \* And indeed that terrible monster that men call algebra many of us brave men (that we are) have not only put to flight, and (fairly) triumphed over; (while) very few of us have dared, with straight-ahead glance, to look into optics; and others still, with intellectual rays unbroken, have dared to pierce their way into the still subtler and highly useful doctrine of dioptries."

From this it would seem that mathematical studies had been introduced into old Cambridge only a short time before Barrow delivered his speech. It thus appears that about 1636, when new Cambridge was founded in the wilds of the west, old Cambridge was not mathematical at all. In further support of this view we quote from the Penny Cyclopædia, article "Wallis," the following statement: "There were no mathematical studies at that time [when Wallis entered Emmanuel College in 1632] at Cambridge, and none to give even so much as advice what books to read. The best mathematicians were in London, and the science was esteemed no better than mechanical. This account is confirmed by his [Wallis's] contemporary, Horrecks, who was also at Emmanuel and whose works Wallis afterwards edited." In a biography of Seth Ward, an English divine and astronomer, we meet with similar testimony.\* He entered Sidney Sussex College, Cambridge, in 1632. "In the college library he found, by chance, some books that treated of the mathematics, and they being wholly new to him, he inquired all the college over for a guide to instruct him that way, but all his search was in vain: those books were Greek, I mean unintelligible, to all the fellows in the college."

If so little was done at old Cambridge, then we need not wonder at the fact that new Cambridge failed to be mathematical from the start. The fountain could not rise higher than its source. It was not until the latter part of the seventeenth century that mathematical studies at old Cambridge rose into prominence. Impelled by the genius of Sir Isaac Newton, old Cambridge advanced with such rapid strides that the youthful college in the west became almost invisible in the distant east.

The mathematical course at Harvard remained apparently the same till the beginning of the eighteenth century. Arithmetic and a little geometry and astronomy constituted the sum total of the college instruction in the exact sciences. Applicants for the master's degree had only to go over the same ground more thoroughly. Says Cotton Mather: "Every scholar that giveth up in writing a system or synopsis or sum of logic, natural and moral philosophy, arithmetic, geometry, and astronomy, is ready to defend his theses or positions, withal sheweth in the originals, as above said, and of godly life . . . is fit to be engaged with the second degree."<sup>2</sup>

The only satisfactory data are the only fragments of information that we could find on the mathematical course at Harvard during the eighteenth century. The following note on the nature of the instruction given in physics is not without interest: Mr. Abraham Pierson, a graduate of Yale College, graduated at Harvard in 1668. The original Yale possesses several of his MSS., "containing notes made by

\* *Life of Seth Ward*, by Walter Pope. London, 1847.

<sup>2</sup> *Collegiate History*, IV, 127-28, 1762.

him during his student life at Harvard on logic, theology, and physics, and so throwing light on the probable compass of the manuscript text-book on physics compiled by him, which was handed down from one college generation to another for some twenty-five years, until superseded by Clarke's Latin translation of Rohault's *Traité de Physique*. The Harvard notes on physics seem (from an inscription attached) to have been derived in like manner from the teachings of the Rev. Jonathan Mitchel (Harvard College, 1647); they are rather metaphysical than mathematical in form, and it is even difficult to determine what theories of physical astronomy the writer held. Suffice it to say that he ranged himself somewhere in the wide interval between the Ptolemaic theory (generally abandoned one hundred years earlier) and the Newtonian theory (hardly known to any one in this part of the world until the eighteenth century). In other words, while recognizing that the earth is round, and that there is such a force as gravity, there is no proof that he had got beyond Copernicus to Kepler and Galileo.\*

In this extract our attention is also called to the common practice among successive generations of students at that time of copying manuscript text books. As another instance of this we mention the manuscript works, a *System of Logic* and a *Compendium Physical*, by Rev. Charles Morton, which (about 1692) were received as text-books at Harvard, "the students being required to copy them."†

We shall frequently have occasion to observe that astronomical pursuits have always been followed with zeal and held in high estimation by the American people. As early as 1651 a New England writer, in naming the "first fruits of the college," speaks of the "godly Mr. Sam Danforth, who hath not only studied divinity, but also astronomy; he put forth many almanacs," and "was one of the fellows of the college." Another fellow of Harvard was John Sherman. He was a popular preacher, an "eminent mathematician," and delivered lectures at the college for many years. He published several almanacs, to which he appended pious reflections. The ability of making almanacs was then considered proof of profound erudition. A somewhat stronger evidence of the interest taken in astronomy was the publication at Cambridge of a set of astronomical calculations by Uriah Oakes. Oakes, at that time a young man, had graduated at Harvard in 1649, and in 1680 became president *pro tem*, and afterwards president of Harvard College. In allusion to his size, he attached to his calculations the motto, "*Parrum parva decent, sed inest sua gratia parvis*," (Small things befit the small, yet have a charm their own.)

The preceding is an account of the mathematical and physical studies at Harvard during the seventeenth century. We now proceed to the eighteenth century. It appears that in 1700 algebra had not yet be-

\* Yale Biographies and Annals, 1701-1745, by Franklin Bowditch Dexter, p. 64.

† Quincy's History of Harvard University, Vol. I, p. 70.

come a college study. The Autobiography of Rev. John Barnard\* throws some light on this subject. Barnard took his first degree at Harvard in 1700, then returned to his father's house, where he betook himself to studying. "While I continued at my father's I prosecuted my studies and looked something into the mathematics, though I gained but little, our advantages therefor being noways equal to what they have who now have the great Sir Isaac Newton and Dr. Halley and some other mathematicians for their guides. About this time I made a visit to the college, as I generally did once or twice a year, where I remember the conversation turning upon the mathematics, one of the company, who was a considerable proficient in them, observing my ignorance, said to me he would give me a question, which if I answered in a month's close application he should account me an apt scholar. He gave me the question. I, who was ashamed of the reproach cast upon me, set myself hard to work, and in a fortnight's time returned him a solution of the question, both by trigonometry and geometry, with a canon by which to resolve all questions of the like nature. When I showed it to him he was surprised, said it was right, and owned he knew no other way of resolving it but by algebra, which I was an utter stranger to." Though a graduate of Harvard, he was an utter stranger to algebra. From this we may safely conclude that in 1700 algebra was not yet a part of the college curriculum.

What, then, constituted the mathematical instruction at that time? Was it any different from the course given in 1633? Until about 1635, the entire college course extended through only three years; at this time it was lengthened to four years. We might have supposed that the mathematics formerly taught in the third year would have been retained as a study for the third or Junior year, but this was not the case. In the four-years' course, mathematics was taught during the last, or Senior year. Quincy, in his history of Harvard University (Vol. I, p. 141), quotes from Walworth's Diary the list of studies for the year 1726. The Freshmen recited in Tully, Virgil, Greek testament, rhetoric, Greek catechism; the Sophomores in logic, natural philosophy, classic authors, Heerebord's *Meletemata*, Wolliebins's *Divinity*; the "Junior sophisters" in Heerebord's *Meletemata*, physics, ethics, geography, metaphysics; while the "Senior sophisters, besides arithmetic, recite Aisted's *Geometry*, Gassendi's *Astronomy* in the morning; go over the arts towards the latter end of the year, Ames's *Medulla* on *Sacraments*, and dispute once a week." This quotation establishes the fact that thirty years after the founding of Harvard, the mathematical course was essentially the same as at the beginning. Arithmetic, geometry, and astronomy still constituted the entire course. Mathematics continued to be considered the crowning pinnacle instead of a corner stone of college education; natural philosophy and physics were

\* *Collected Works of the Mass. Hist. Soc., Third Series, Vol. V, pp. 177-213.*

still taught before arithmetic and geometry. But we must observe that, in 1726, *printed* treatises were used as text-books in geometry and astronomy. We are not informed at what time these printed books were introduced. They may have been used as text-books much earlier than the above date. The authors of these books were in their day scholars of wide reputation. Johann Heinrich Alsted (1553-1638), the author of the Geometry, was a German Protestant divine, a professor of philosophy and divinity at Herborn in Nassau, and afterwards in Carlsburg in Transylvania. In one of his books he maintained that the millenium was to come in 1694.

Pierre Gassendi (1592-1655), whose little astronomy of one hundred and fifty pages was used as a class-book at Harvard, was a contemporary of Descartes and one of the most distinguished naturalists, mathematicians, and philosophers of France. He was for a time professor of mathematics at the Collège Royal of Paris. What seems very strange to us is that nearly a century after the first publication of these books they should have been still in use and apparently looked upon as the best of their kind. Forty years after the publication of Newton's Principia an astronomy was being studied at Harvard whose author died before the name of Newton had become known to science. The wide chasm between the theories of Newton and those of Gassendi is brought to full view by the following quotation from Whewell's History of the Inductive Sciences (Third edition, Vol. I, p. 392): "Gassendi's own views of the causes of the motions of the heavenly bodies are not very clear. • • • In a chapter headed 'Quæ sit motrix siderum causa,' he reviews several opinions; but the one which he seems to adopt is that which ascribes the motion of the celestial globes to certain fibers, of which the action is similar to that of the muscles of animals. It does not appear therefore that he had distinctly apprehended, either the continuation of the movements of the planets by the first law of motion, or their deflection by the second law."

The year 1726 is memorable in the annals of Harvard for the establishing of the Hollis professorship of mathematics. Thomas Hollis, a kind-hearted friend of the college, transmitted to the treasurer of the college the then munificent sum of twelve hundred pounds sterling, and directed that the funds should be applied to "the instituting and settling a professor of mathematics and experimental philosophy in Harvard College." To the same benefactor Harvard was indebted for the establishment of the professorship of divinity. Down to the commencement of the nineteenth century only one additional professor was appointed in the undergraduate department, namely, the Hancock professor of Hebrew, in 1765. Hence, it follows that almost all regular instruction was given by tutors. Previous to the establishment of the Hollis professorship the mathematical instruction was entirely in the hands of tutors. Since almost any minister was considered competent to teach mathematics, and since tutors held their place sometimes for



only one year, we may imagine that the teaching was not of a very high order.

The first appointment to the Hollis professorship of mathematics and natural philosophy was that of Isaac Greenwood. He was the first to occupy a collegiate chair of mathematics in New England, but not the first in America, as is sometimes stated. This honor belongs to a professor at William and Mary College. Greenwood graduated at Harvard in 1721, then engaged in the study of divinity, visited England, and began to preach in London with some approbation.\* He also attended lectures delivered in that metropolis on experimental philosophy and mathematics. In 1727 he entered upon his duties at Harvard. "In scientific attainments Greenwood seems to have been well qualified for his professorship." He made astronomical contributions to the *Philosophical Transactions* of 1728, and published in 1729 an arithmetic. That seems to have been the earliest arithmetic from the pen of an American author. This is all we know of Greenwood as a mathematician and teacher. Unfortunately he did not prove himself worthy of his place. We regret to say that the earliest professor of mathematics in the oldest American college was "guilty of many acts of gross intemperance, to the dishonor of God and the great hurt and reproach of the society." His intemperance brought about his removal from his chair in 1738.

On the dismissal of Greenwood, Nathaniel Prince, who had been tutor for thirteen years, aspired to the professorship. He was, says Elliot, superior "to any man in New England in mathematics and natural philosophy." But his habits being notoriously irregular, John Winthrop of Boston, was appointed in his stead. Winthrop graduated at Harvard in 1732, and was only twenty-six years old when he was chosen professor of mathematics and natural philosophy. He filled this chair for over forty years (until 1779) with marked ability. In mathematical science he came to be regarded by many the first in America.

If we could turn the wheel of time backward through one hundred and twenty revolutions, and then enter the lecture room of Professor Winthrop and listen to his instruction, what a chapter in the history of mathematical teaching would be uncovered! But as it is, this history is hidden from us. We know only that during the early part of his career as professor, "and probably many years before," the textbooks were the following: Ward's *Mathematics*, Gravesande's *Philosophy*, and Euclid's *Geometry*; besides this, lectures were delivered by the professors of divinity and mathematics.<sup>†</sup>

From this we see that some time between the years 1726 and 1738, Ward's *Mathematics* had been introduced, and Aisted's old *Geometry* had given place to the still older but ever standard work of Euclid. This is the first mention of Euclid as a text-book at Harvard. The in-

\* Quincy's *History of Harvard University*, Vol. II, p. 14.

† Peirce's *History of Harvard*, p. 237.

introduction of Gravesande's Philosophy is another indication of progress. Gravesande was for a time professor of mathematics and astronomy at the University of Leyden. He was the first who on the continent of Europe publicly taught the philosophy of Newton, and he thus contributed to bring about a revolution in the physical sciences. By the adoption of his philosophy as a text-book at Harvard we see that the teachings of Newton had at last secured a firm footing there. Ward's Mathematics continued for a long time to be a favorite text-book.\*

It is probable that with the introduction of Ward's Mathematics, algebra began to be studied at Harvard. The second part of the Young Mathematician's Guide consists of a rudimentary treatise on this subject. It is possible, then, that the teaching of algebra at Cambridge may have begun some time between 1726 and 1738. But I have found no direct evidence to show that algebra actually was in the college curriculum previous to 1786.

Since Ward's Mathematics were used, to our knowledge, not only at Harvard, but also at Yale, Brown, and Dartmouth, and as a book of reference at the University of Pennsylvania, a description of the Young Mathematician's Guide may not be out of place.†

The first part treats of arithmetic (143 pages). Though very deficient according to modern notions, the presentation of this subject is superior to that in Dilworth's School-master's Assistant. It is less obscure.

\* According to ex-President D. Woolsey, the author of this book was the Ward who had been "president of Trinity College, Cambridge, and bishop of Exeter." (Yale College: A Sketch of its History, William L. Kingsley, Vol. II, p. 439.) Now, the only individual answering to this description is Seth Ward, the astronomer, whose time of activity preceded the epoch of Newton. We shall show that the book in question was not written by Seth Ward, but by John Ward, who flourished half a century later than Seth Ward and whose Young Mathematician's Guide was for a long time a popular elementary text book in England. Wherever we have seen Ward's book mentioned in the curricula of American colleges it was always called "Ward's Mathematics." The baptismal name of the author was never given. This shows that there was only one Ward (either Seth or John) whose mathematical books were known and used in our colleges. Now, Benjamin West, professor of mathematics in Brown University from 1786 to 1799, published in the first volume of the American Academy of Arts and Sciences a paper "On the extraction of roots," in which he offers improvements on "Ward's" method. Now, I have seen a copy of Seth Ward's *Astronomia Physico-Mathematica* but have found nothing in it on root extraction. One would hardly expect to find anything on it in Seth's "Trigonometry" or "Proportion." John Ward, on the other hand, treats of roots in his "Guide," and gives a "general method of extracting roots of all single powers." West takes two examples (two numbers, one of 11, the other of 18 digits) from "Ward," and shows how the required roots can be extracted by his method. But both these examples are given in John Ward's Young Mathematician's Guide. This evidence in favor of John Ward's book may be considered conclusive. Further information on "Ward's Mathematics" will be found in an article by the writer in the Papers of the Colorado College Scientific Society, Vol. I.

† The copy which the writer has before him (Twelfth edition, London, 1771), was kindly lent him by Dr. Artemas Martin, of the U. S. Coast Survey, who has for years been making a collection of old and rare books on mathematics.

Like all books of that time, it contains rules, but no reasoning. What seems strange to us is the fact that subjects of no value to the beginner, such as arithmetic and geometrical proportion (*i. e.*, progression), addition, square root, cube root, biquadrate root, sursolid root, etc., are given almost as much space and attention as common and decimal fractions.

The second part (110 pages) is devoted to algebra. Ward had published a small book on algebra in 1698, but that, he says, was only "a compendium of that which is here fully handled at large." Like Harriot, he speaks of his algebra as "Arithmetick in species." This name is appropriate, inasmuch as he does not (at least at the beginning) recognize the existence of negative quantities, but speaks of the *minus sign* always as meaning only subtraction, as in arithmetic. A little further on, however, he brings in, by stealth, "affirmative" and "negative" quantities. The knowledge of algebra to be gotten from this book is exceedingly meagre. Factoring is not touched upon. The rule of signs in multiplication is proved, but further on all rules are given without proof. The author develops a rule showing how binomials can be raised to what height you please without the trouble of continued involution." He then says: "I proposed this method of raising powers in my Compendium of Algebra, p. 57, as wholly new (*viz.*, as much of it as was then useful, having then (I profess) neither seen the way of doing it, nor so much as heard of it's being done. But since the writing of that tract, I find in Doctor Wallis's History of Algebra, pp. 319 and 331, that the learned Sir Isaac Newton had discovered it long before." The subject of "interest" is taught in the book algebraically, by the use of equations.

Part III (78 pages) treats of geometry. In point of precision and scientific rigour, this is quite inferior. After the definitions follow twenty problems intended for the excellent purpose of exercising the "young practitioner" and bringing "his hand to the right management of a tract of reasoning, wherein I would advise him to be very ready and exact." Then follows a collection of twenty-four "most useful theorems in plane geometry demonstrated." This part is semi-empirical and semi-analytical. A few theorems are assumed and the rest proved by means of these. The theorem, "If a right line cut two parallel lines, it will make the opposite (*i. e.*, alternate interior) angles equal to one another," is proved by aid of the theorem, that "If two lines intersected by a third, the cross-angles will be equal." The proof is based on the fact that two parallel lines are, as it were, but one broad line, obtained by moving one parallel toward the other, the figure for the former theorem reduces to that of the latter. The next chapter contains three general demonstrations of twenty geometrical problems.

Part IV, consisting of thirty pages, gives a semi-empirical treatment of the conic sections, with the definition of a cone, it shows how the parabola is generated from it, and then gives some of *their principal properties*.

Part V (36 pages) is on the arithmetic of infinites. Judging from this part of the book, its author knew nothing of fluxions. The first edition appeared in 1707, after Newton had published the first edition of his Principia, in 1687, but his Method of Fluxions was not published till 1736, though written in 1671. Ward employs the method of integration by series of Cavalieri, Roberval, and John Wallis, and, thereby, finds the superficial and solid contents of solid figures. It does not appear that this part of the book was ever studied in American colleges.

Ward's book met with favor in England. In the preface to the twelfth edition he says: "I believe I may truly say (without vanity) this treatise hath proved a very helpful guide to near five thousand persons, • • • and not only so, but it hath been very well received amongst the learned, and (I have been often told) so well approved on at the universities, in England, Scotland, and Ireland, that it is ordered to be publicly read to their pupils."

In former times all professors of mathematics in American colleges gave instruction, not merely in pure mathematics, but also in natural philosophy and astronomy; and it appears that as a general rule these professors took more real interest and made more frequent attempts at original research in the fields of astronomy and natural philosophy than in pure mathematics. The main reason for this lies probably in the fact that the study of pure mathematics met with no appreciation and encouragement. Original work in abstract mathematics would have been looked upon as useless speculations of idle dreamers. The scientific activity of John Winthrop was directed principally to astronomy. His reputation abroad as a scientist was due to his work in that line. In 1740 he made observations on the transit of Mercury, which were printed in the Transactions of the Royal Society. In 1761 there was a transit of Venus over the sun's disk, and as Newfoundland was the most western part of the earth where the end of the transit could be observed, the "province" sloop was fitted out *at the public expense* to convey Winthrop and party to the place of observation.\* He took with him two pupils who had made progress in mathematical studies. One of these, Samuel Williams, became later his successor at Harvard. In 1769 Winthrop had another chance for observing the transit of Venus, at Cambridge. "As it was the last opportunity that generation could be favored with, he was desirous to arrest the attention of the people. He read two lectures upon the subject in the college chapel, which the students requested him to publish. The professor put this motto upon the title page: *Agite, mortales! et oculos in spectationem vertite, quod hucusque spectaverunt perpaucaissimi; spectaturi iterum sunt nulli.*" O'ompe, mortals! and turn your eyes upon a sight which, to this day, but few have seen, and which not one of us will ever see again.) The transit of 1769 was also observed in Philadelphia by David Rittenhouse, and in Providence by Benjamin West. These observations

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\* "John Winthrop," in the Biographical Dictionary by John Elliot, 1843.

were an important aid in determining the sun's parallax. Most gratifying to us is the interest in astronomical pursuits manifested in those early times. Expeditions fitted out at public expense, and private munificence in the purchase of suitable instruments, bear honorable testimony to the enlightened zeal which animated the friends of science.

In 1767 John Winthrop wrote his *Cogita de Cometis*, which he dedicated to the Royal Society, of which he had been elected a member. This was reprinted in London the next year, and gave him an extensive literary reputation.

In 1764 a calamity befell Harvard College. The library and philosophical apparatus—the collections of over a century—were destroyed by fire. Among the books recorded as having been lost are the following: "The Transactions of the Royal Society, Academy of Sciences in France, Acta Eruditorum, Miscellanea Curiosa, the works of Boyle and Newton, with a great variety of other mathematical and philosophical treatises."\* It is seen from this that, before the fire, books of reference in higher mathematics had not been entirely wanting.

John Winthrop died in 1779, and the robe of the departing prophet fell upon his former disciple, the Rev. Samuel Williams. Williams filled the mathematical chair for eight years. Having inherited from his master a love of astronomy, he frequently published observations and notices of extraordinary natural phenomena in the memoirs of the American Academy of Arts and Sciences. He occupied the mathematical chair at Harvard until 1788. Then he lectured at the University of Vermont on astronomy and natural philosophy for two years, and was subsequently minister at Rutland and Burlington, Vermont.

#### YALE COLLEGE.

Yale, the second oldest New England college, was founded in 1701, or sixty-three years after the opening of Harvard. During the first fifteen years it maintained a sort of nomadic existence. Previous to 1816 instruction seems to have been given partly at Saybrook and partly at Killingworth and Milford. Its course of instruction was then very limited. The mathematical teaching during the first years of its existence was even more scanty than in the early years at Harvard. Benjamin Leitch a Yale graduate of 1714, wrote in 1779 as follows in reply to inquiries by the *Edinburgh Review*: "As for mathematics, we recited and studied until we understood the rudiments of it, some of the plainest things in it. Our advantages in that way were too low for any to rise high in any branch of literature." Doctor Johnson, of the same class, says: "Common Arithmetick and a little surveying were the *ac plus ultra* of mathematical acquisitions." It appears from this that *surveying* was taken at Yale instead of the *geometry* which formed part

\* See *History of Harvard University*, Vol. II, p. 4-1.

\* *Yale Biographical Annals, 1701-45*, by Franklin Bowditch Dexter, pp. 115 and 116.

of the course at Harvard. In a new and only partially settled country some knowledge of surveying was a great desideratum. But the study of surveying without a preliminary course in geometry and trigonometry is truly characteristic of the purely practical tendencies of the times. Men took eager interest in the applications of science, but cared nothing for science itself. The little mathematics studied was evidently not pursued for its own sake, nor for the mental discipline which it afforded, but simply for the pecuniary profit which it would afterwards bring.

As at Harvard, so at Yale, the mathematics were studied, at that time, during the last year of the college course and after the study of physics had been completed.\* During the next six or seven years, the course at Yale was extended somewhat. In 1720 it was identical with the Harvard course of 1726. In 1719, when Jonathan Edwards was a member of the Junior class at New Haven, he wrote as follows to his father: "I have enquired of Mr. Cutter, what books we shall have need of the next year. He answered he would have me get against that time, *Alsted's Geometry and Gassendi's Astronomy*."†

At this time progress was also made in the teaching of physics. The earliest guide in this study were the manuscript lectures by Rector Pierson, which were a repetition of lectures he had heard while a student at Harvard College. They were metaphysical rather than mathematical, "recognizing the Copernican theory, but knowing nothing of Kepler and Galileo, and much less of Newton."‡

During the first seventeen years at Yale the doctrines of the schoolmen in logic, metaphysics, and ethics still held sway. Descartes, Boyle, Locke, Bacon, and Newton were regarded as innovators from whom no good could be expected. It is pleasing to think that the introduction of Newtonian ideas and the rise of mathematical studies at Yale was partly due to an act of charity by the great Sir Isaac Newton himself. In the year 1715 a collection of books made in England by Mr. Drummer, the agent of the colony, amounting to about eight hundred volumes, was sent over to the college. The collection consisted of donations by well-spirited gentlemen in Britain. "Sir Isaac Newton gives the second edition of his *Principia* (which appeared in 1713)"; "Doctor Halley sends his edition of *Apollonius*."§ But these and many other donations would have been barren of results had there not been young men of talent and energy to master the contents of these precious volumes. Such a man was Samuel Johnson. He graduated in 1714 and was appointed tutor a few years later. Drummer's collection furnished him with a "feast of fat things." To use his own words: "He seemed to himself like a person suddenly emerging out of the glimmer of twilight into the full sunshine of open day." He and

\* Yale College: a sketch of its history. William L. Kingsley, Vol. II, p. 436.

† Edwards' Works, Vol. I, p. 30.

‡ Ex-President D. Woolsey, in Yale Book, Vol. II, p. 490.

§ Yale Biographies and Annals, 1701-6, by Franklin Bowditch Dexter, p. 141.

Mr. Brown, another young tutor, exerted themselves to the utmost for the improvement of the students under their charge. Imbued with the grand ideas of Newton, they extended the mathematical course for the understanding of the Newtonian system, and then taught this system in place of the older. There was at that time much contention as to the place where the college should be permanently located. This was a tortuous circumstance for the young tutors, since these troubles without withdrew public attention from the innovations within.\* In 1722 Johnson and Brown resigned their tutorships and sailed for England to receive ordination from an English bishop. Johnson became later president of King's (now Columbian) College in New York.

Soon after this the *Physique* of Robault was introduced at Yale as a text-book. Robault (1620-75) was a French philosopher and an implicit follower of the Cartesian theory. The edition used was that by the celebrated Samuel Clarke, who had taken the rugged Latin version of the treatise of Robault (then used as a text-book at the University of Cambridge, England), and published it in better Latin, together with numerous critical notes, which he had added with a view of bringing the Cartesian system into disrepute by exposing its fallacies. This discredited Newtonian treatise maintained its place at Yale until 1743, when it was superseded by the work of Gravesande.

During President Chapin's time, Martin's *Philosophy*, in three volumes, was the text-book in this science, when this work came to be out of print, President Stiles procured Field's *Philosophia*, which was the first introduction into American colleges of that now obsolete work.

It is worthy of remark that, in 1749, Benjamin Franklin presented to the college an electric machine, and that, a few years later, Ezra Stiles, then tutor of the college, began to make experiments with it. These are supposed to have been the earliest of the kind made in New England.

It appears that in 1753, Euclid was being used as a text-book in geometry. The earliest mention of Euclid at Harvard is in 1737. In 1753, Daniel H. of New Haven, who had received the honorary degree of Master of Arts three years previously, testified his gratitude by writing to the trustees of the college, "the rectors of Yale College."

He said: "I have the honor to acknowledge the books by Joseph Thompson, D.D., of the college of New-Haven, which I have received."

"The Elements of Mathematics,  
by Euclid, translated by Thomas  
Tait, and published by the  
University of Cambridge."

"The Elements of Algebra, by Simon Stevin."

The trustees of the college presented to the college also "a complete reflecting telescope, of 24 inches diameter, and 22 feet long." "A reflecting telescope, and a complete reflecting telescope, and mathematical instruments—valued at £250—were presented to the college from the trustees and others."

\* See *Annals of the College of William and Mary*, Vol. 1, p. 17, and Johnson.

† See *Annals of the College of William and Mary*, Vol. 1, p. 17.

‡ See *ibid.*

In 1742, elementary mathematics came to be removed from its august position in the curriculum as a senior study, and to be assigned an humbler but more befitting place nearer the beginning of the course. In 1742 the rector of the college advised the students to pursue a regular course of academic studies in the following order: "In the first year to study principally the tongues, arithmetic, and algebra; the second, logic, rhetoric, and geometry; the third, mathematics, and natural philosophy; and the fourth, ethics and divinity."<sup>\*</sup>

That these changes were not made earlier than 1742 is evident from a passage in the memoir of Samuel Hopkins, who graduated in 1741, stating that then "metaphysics and mathematics found their place ~~in~~ in the fourth year, being in their turn the subject of study and recitation for the first four days of every week."<sup>†</sup>

At what time this dethronement of elementary mathematics as a senior study took place at Harvard, we are not able to state. It will be noticed that, at Yale, mathematics and natural philosophy had at this period exchanged places, the former now preceding the latter. From the above it is also evident that algebra was studied at Yale in 1742. The earliest mention of algebra at Cambridge is in 1786, though it doubtless began to be taught there much earlier. What branch of mathematics constituted the study for the third or Junior year remains a matter of conjecture. The "mathematics" spoken of in the extract probably referred to trigonometry, possibly together with some other branches.

A strong impetus to the study of mathematics at Yale was given during President Clap's administration. Thomas Clap graduated at Harvard in 1722. Doctor Stiles, his successor in the presidency at Yale, says that Clap studied the higher branches of mathematics, and was one of the first philosophers America has produced, "that he was equalled by no man, except the most learned Professor Winthrop." In his history of Yale, written in 1766, the year of his resignation, President Clap gives the following account of the studies pursued by students at the college:

"In the first year they learn Hebrew, and principally pursue the study of the languages, and make a beginning in logic and some parts of the mathematics. In the second year they study the languages, but principally recite logic, rhetoric, oratory, geography, and natural philosophy: and some of them make good proficiency in trigonometry and algebra. In the third year they will pursue the study of natural philosophy and most branches of mathematics. Many of them well understand surveying, navigation, and the calculation of eclipses: and some of them are considerable proficient in *conic sections* and *fluxions*. In the fourth year they principally study and recite metaphysics, ethics, and divinity."<sup>‡</sup>

<sup>\*</sup>Yale Bulletin, 1888 and Annals, 1791-18, p. 724.

<sup>†</sup>New Englander, August, 1854, p. 42; Professor Park's Memoir of Hopkins.

<sup>‡</sup>Yale College: a Sketch of its History, by Wm. L. Kingsley, Vol. II, pp. 437 and 438.



The mathematical course in the above curriculum is indeed one that Yale had reason to be proud of. It shows that not only algebra and geometry, but also trigonometry, and even conic sections and fluxions, were studied at Yale previous to the year 1766. This is the earliest distinct mention of conic sections and fluxions as college studies in America.

Mathematics seem to have come to occupy some of the time which was given at first to logic. President Clap does not enumerate the text-books employed, but his successor, Doctor Stiles, in his diary for November 9, 1779, mentions a list of books recited in the several classes at his accession to the presidency, in 1777. The mathematical books are, for the Freshman class, Ward's Arithmetic; Sophomore class, Hammond's Algebra, Ward's Geometry (Saturday), Ward's Mathematics; Junior class, Ward's Trigonometry, Atkinson and Wilson's Trigonometry.

On comparing this mathematical course with that given by President Clap eleven years previous we observe some changes. The study of conic sections and fluxions had been apparently discontinued. This want of mathematical enthusiasm was probably due to the departure of President Clap, and also to the political disturbances and confusions of the times. It would seem that during Clap's administration not all the students took higher mathematics, but only those who were particularly fond of them. Clap says, "*Many of them well understand surveying, navigation, and the calculation of eclipses; and some of them are considerable proficient in the conic sections and fluxions.*"

That optional studies were then pursued occasionally is evident from a statement by President Stiles that he began instructing a class in Hebrew and Oriental languages, which he "selected out of all other classes, as they voluntarily offered themselves." The extent to which each of these branches was studied may probably be correctly inferred from the contents of Ward's Young Mathematician's Guide. This consists of five parts: arithmetic, algebra, geometry, conic sections, and arithmetic of infinites. Students that were mathematically inclined went through the entire work it would seem, excepting the algebra, which was studied from Hammond's book.

The year 1770 is memorable for the creation of the chair of "mathematics and natural philosophy" at Yale. This was done apparently to fill the gap caused by the departure of President Clap, who was uncommonly skilled in those sciences. The first occupant of this chair was Nicholas de Strasz, who kept it eleven years. He belonged to the class of 1757 at Yale, and was tutor there from 1757 to '60. Before entering upon the duties of his chair, he had been pastor. After his resignation of the chair, he entered upon the study and practice of law. He published "*Astronomy Improved*" (New Haven, 1781). President T. D. Gilman speaks of him as "a man of vigorous understanding."

## WILLIAM AND MARY COLLEGE.

William and Mary is next to Harvard the oldest of American colleges. From 1688, the year of its organization at Williamsburg, Va., until the inauguration of the University of Virginia, it was the leading educational institution in the South. Owing to the repeated destruction by fire of the college buildings and records, not even the succession of the professors has been preserved. The early courses were in all probability much the same as the contemporaneous courses at Harvard. According to Campbell, 5 professorships were provided for by the charter, namely, those of Greek and Latin, mathematics, moral philosophy, and two of divinity. In speaking of the early course of study, Howison says that it embraced also a "natural philosophy which was just beginning to believe that the earth revolved round the sun, rather than the sun round the earth."

The earliest mathematical professor at William and Mary whose name has come down to us, was Rev. Hugh Jones. The college had a *professorship* of mathematics from its very beginning, and at a date when mathematical teaching at Harvard was still in the hands only of tutors. The names of the predecessor or predecessors of Hugh Jones are not known. He is the earliest *professor* of mathematics in America whose name has been handed down to us. He was an Englishman of university education; came to Maryland in 1696; was for a time pastor of a church; and then was appointed to the chair of mathematics at William and Mary. He was a man of broad, scholarly attainments, and endeared himself to the student of history quite as much as to the mathematician, by writing his invaluable book on *The Present State of Virginia* (1724). Says Dr. Herbert B. Adams: "His monograph is acknowledged to be one of the best sources of information respecting Virginia in the early part of the eighteenth century." The following quotations from it (p. 44) may be of interest: "They (the Virginians) are more inclinable to read men by business and conversation than to dive into books, and are for the most part only desirous of learning what is absolutely necessary in the shortest and best method."

"Having this knowledge of their capacities and inclination from sufficient experience, I have composed on purpose some short treatises adapted with my best judgment to a course of education for the gentlemen of the plantations, consisting in a short *English Grammar*, an *Accidence of Christianity*, an *Accidence to the Mathematick* in all its parts and applications, *Algebra*, *Geometry*, *Surveying of Land*, and *Navigation*."

"These are the most useful branches of learning for *them*, and such as they willingly and readily master, if taught in a plain and short method, truly applicable to their *genius*; which I have endeavored to do, for the use of *them* and *all others* of their temper and parts."

We are not to understand by the above that his "Accidence to the

*Mathematick*" and the other books mentioned were actually printed; they existed only in manuscript copies. From the above it appears that about 1724 the mathematical course at William and Mary was quite equal to that in either of the two New England colleges. We must, of course, guard ourselves against the impression that full and exhaustive courses were given in algebra, geometry, surveying, and navigation. As is pointed out by the author himself, the merest rudiments only were imparted.

Reverend Jones was succeeded by Alexander Irvine, and he in turn by Joshua Fry. Fry was educated at Oxford, and, after coming to this country, was made master of the grammar school connected with William and Mary, and later, professor of mathematics in the college. In company with Peter Jefferson, the father of Thomas Jefferson, he made a map of Virginia. He also served on a commission appointed to determine the Virginia and North Carolina boundary line. He was succeeded in 1758 by William Small.

A few years before the outbreak of the Revolutionary War William and Mary College had among her students several who afterwards rose to prominence; she had four who became signers of the Declaration of Independence, and also the illustrious Thomas Jefferson, who became the author of this great document. At William and Mary, Jefferson was a passionate student of mathematics. The college long exercised the duties of the office of surveyor-general of the Colony of Virginia. Thomas Jefferson's father was a practical surveyor, who had been chosen in 1747 by Joshua Fry, then professor of mathematics at William and Mary, to continue the boundary line between Virginia and North Carolina.

When Thomas Jefferson, at the age of seventeen, entered the Junior class, he came into intimate relation with Dr. William Small, of Scotland, who was then the professor of mathematics. As an instructor he had the happy gift of making the road of knowledge both easy and profitable. In his Autobiography Jefferson says: "It was my great good fortune, and what probably fixed the destinies of my life, that Dr. William Small, of Scotland, was then professor of mathematics, a man profound in all the useful branches of science, with a happy talent of communicating instruction and gentlemanly manners, and an enlarged and liberal spirit. He most happily for me, became soon attached to me, and I received his daily company when not engaged in the school; and from his conversations I got my first views of the expansion of science, and of the system of things in which we are placed."

In 1774 Dr. Small was appointed surveyor of the county of Albemarle. But the college of William and Mary left its stamp upon Jefferson, not merely as a qualified surveyor, but also as a statesman, philosopher, economist, and educator. We dwell with special interest upon his association at college with Dr. Small, because in later years, when filling the office of President of the United States, we shall marvel at the rich fruits his early association with a lover of exact science brought

forth. It was during Jefferson's administration that a systematic plan of conducting the Government surveys of the great North-West Territory was initiated; it was during his administration that the great work of the U. S. Coast Survey was first inaugurated. He took also great interest in the enlargement of the U. S. Military Academy. In these great movements the personal interest and enlightened zeal of Jefferson himself were the primary motive power. His biographers tell us that he was the first discoverer of the formula for constructing the mould-board of a plow on mathematical principles. He wrote to Jonathan Williams on this subject, July 3, 1796: "I have a little matter to communicate, and will do it ere long. It is the form of a mould board of *least resistance*. I had some years ago conceived the principles of it, and I explained them to Mr. Rittenhouse." We quote the following to show that even in his old age he still loved the favorite study of his youth. Said he in a letter to Col. William Duane, dated October, 1812, "When I was young, mathematics was the passion of my life. The same passion has returned upon me, but with unequal powers. Processes which I then read off with the facility of common discourse, now cost me labor and time, and slow investigation." Of interest are also certain passages in a course of legal study which he drew up for a young friend: "Before you enter on the study of law a sufficient groundwork must be laid. . . . Mathematics and natural philosophy are so useful in the most familiar occurrences of life and are so peculiarly engaging and delightful as would induce every one to wish an acquaintance with them. Besides this, the faculties of the mind, like the members of the body, are strengthened and improved by exercise. Mathematical reasoning and deductions are, therefore, a fine preparation for investigating the abstruse speculations of the law." Among the books in mathematics recommended by Jefferson to his young friend are, Bezout's *Cours de Mathématique*—the best for a student ever published; Montucla, or Bossut, *Histoire des Mathématiques*; Astronomy—Ferguson, and Le Monnier or De Lalande.

It should not be left unmentioned here that George Washington once applied to the College of William and Mary for an elective course in land surveying, and that he received his first commission as county surveyor from the faculty of the college. In this connection we can not refrain quoting a passage from the excellent monograph by Dr. Herbert B. Adams on the College of William and Mary.\* "It is interesting," says he, "to trace the evolution of men as well as of institutions. It is generally known that Washington began his public life as a county surveyor, but, in all probability, few persons have ever thought of his service in that office as the historical and economic germ of his political greatness. Most people regard this early work as a passing incident in his career, and not as a determining cause, and yet it is possible to show that Washington's entire public life was but the natural out-

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\* Circular of Information of the Bureau of Education, No. 1, 1887, p. 30.

growth of that original appointment given him in 1749, at the age of seventeen, by the College of William and Mary. That appointment, in the colonial days of Virginia, was the equivalent of a degree in civil engineering, and it is interesting to observe what a peculiar bias it gave to Washington's life before and after the Revolution."

Professor Small's successors in the mathematical chair at William and Mary were Rev. Thomas Gwatkin, George Blackburn, Ferdinand S. Campbell, Robert Saunders, Benjamin S. Ewell, and Thomas T. L. Snead.

#### UNIVERSITY OF PENNSYLVANIA.

The University of Pennsylvania was chartered in 1755, and was known before the Revolution as the College, Academy, and Charitable School of Philadelphia. The celebrated Dr. William Smith, D. D., was the first provost. He was a man of great learning and superior executive ability. Under his administration, previous to the outbreak of the Revolution, the college made marvellous progress. The teachers were men of well-established reputation throughout the colonies. Dr. Smith, who was very fond of mathematical studies, gave lectures on mathematics, natural philosophy, astronomy, and rhetoric. In 1769 he appears as one of the founders of the American Philosophical Society. The first volume of the transactions of that society contains accurate observations by Rittenhouse and himself of the transits of Venus and Mercury. Associated with him at the college as professor of mathematics, from 1760 to 1763, was Hugh Williams. He was a graduate of the institution, and a minister. Afterward he studied medicine abroad and then practiced in Philadelphia. He took great interest in astronomy, and observed the transit of Venus and Mercury for the Philosophical Society.

Theophilus Grew is also mentioned as a mathematical instructor. Rev. Ebenezer Kinnersley, Franklin's assistant in his electrical experiments, gave instruction in physics. "In this institution," says Dr. Smith, "there is a good apparatus for experiments in natural philosophy, done in England by the best hands and brought over from thence in different parcels. There is also in the experiment room an electrical apparatus, chiefly the invention of one of the professors, Mr. Kinnersley, and perhaps the completest of the kind now in the world." The courses of study mapped out by Dr. Smith are preserved in his works.\* According to this, the mathematical and physical instruction during the three years at college was as follows (in 1758):

*First year*—Euclid's elemental arithmetic reviewed, including fractions and the extraction of roots; algebra through simple and quadratic equations, and logarithms; arithmetic; first six books of Euclid.

*Second year*—Plane and spherical trigonometry; surveying, dialing, navigation; seventh and twelfth books of Euclid; conic sections; fluxions; architecture, and natural philosophy.

*Third year*—Light and color, optics, perspective, astronomy.

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\* William Smith's Works, 1794, p. 238.

There is given, in addition to this, the following list of "books recommended for improving the youth in the various branches."

*First year.*—Barrow's Lectures, Pardie's Geometry, Maclaurin's Algebra, Ward's Mathematics, Keil's Trigonometry.

*Second year.*—Patoun's Navigation, Gregory's Geometry and Fortification; Simson's Conic Sections; Maclaurin's and Emerson's Fluxions.

*Third year.*—Helsbam's Lectures; Gravesande; Cote's Hydrostatics; Desaguliers; Muschenbroec; Keil's Introduction; Martin's Philosophy, Maclaurin's View of Sir Isaac Newton's Philosophy, Rohault per Clarke.

It appears that the instruction was given by lectures, the books of which the above is a partial list, were (says Dr. Smith) "to be consulted occasionally in the lectures, for the illustrations of any particular part; and to be read afterwards, for completing the whole." How closely this advanced curriculum of Dr. Smith was adhered to, and how nearly his ideal scheme came to be realized in the actual work of the college, we have no means of determining. This much is certain, that before the Revolution the institution attracted a large number of students. According to Dr. Smith, the attendance in the college alone went as high as one hundred, while the total attendance, including the pupils of the academy and charity schools, surpassed three hundred. Of the course of study which he planned for the institution, it has been said by competent judges that "no such comprehensive scheme of education then existed in the American colonies."

But there followed a reaction. Political troubles at the beginning of the Revolutionary War broke up the institution. The authorities of the college were accused of disloyalty, and in 1779 the charter was annulled by the Provincial Assembly, and the college estate vested in a new board. Dr. Smith was ejected, and in 1791 there was organized the "University of Pennsylvania." Many years elapsed before the institution regained the popularity it enjoyed before the war.

#### SELF-TAUGHT MATHEMATICIANS.

The mathematicians mentioned in the previous pages were all men engaged in the profession of teaching. But, strange as it may seem, the most noted mathematician and astronomer of early times was not a professor in a college, nor had he been trained within college walls. We have reference to David Rittenhouse. He was born near Germantown, Pa., in 1732. Until about his eighteenth year, he was employed on his father's farm. The advantages for obtaining an education in rural districts were then exceedingly limited, but the elasticity of his genius was superior to the pressure of adverse fortune. At the age of twelve he came in possession of a chest of carpenter's tools, belonging to an uncle of his, who had died some years previously. This chest contained, besides the implements of trade, several elementary books treating of arithmetic and geometry. This humble coffer was to him an invaluable treasure, for the tools afforded him some means of exercising

the bent of his genius toward mechanics, while the books early led his mind to those pursuits for which it was pre-eminently fitted. While a boy he is said to have covered the fences and plows on his father's farm with geometrical figures. At the age of seventeen he constructed a wooden clock.

The delicacy of his constitution and the irresistible bent of his genius induced his parents to yield to his oft-repeated wish of giving up farming, and to procure for him the tools of a clock and mathematical instrument maker. Rittenhouse now worked diligently with his tools during the day, and at night spent a portion of his time which should have been passed in taking repose in the prosecution of his studies. His success seems to have been extraordinary, for his biographers assert that before the age of twenty he was able to read the *Principia*, and that he had discovered the method of fluxions without being aware that this had already been done by Newton and Leibnitz. In *Sparks's American Biography* we read that since Newton in his *Principia* "follows the synthetic method of demonstration and gives no clue to the analytic process by which the truth of this proposition was first discovered by him, . . . Rittenhouse began to search for the instrument which might be applied to the purpose of similar discoveries, and in his researches attained the principles of the method of fluxions."

Dr. Rush, in his eulogy on Rittenhouse, says in the same way: "It was during the residence of our ingenious philosopher with his father in the country that he made himself master of Sir Isaac Newton's *Principia*, which he read in the English translation of Mr. Motte. It was here, like wise, he became acquainted with the science of fluxions; of which self-taught invention he believed himself, for a while, to be the author, nor did he know for some years afterwards that a contest had been carried on between Sir Isaac Newton and Leibnitz for the honor of the great and useful discovery. What a mind was here! Without literary aids or society, and with but two or three books, he became, before he had reached his four and twentieth year, the rival of two of the greatest mathematicians in Europe."

Our information concerning the studies of our young philosopher is so scanty that we find it impossible to determine the exact range of his thought, or the consequences that flowed from them. Not the slightest information as to the exact nature of his alleged invention has been preserved, and himself seems to have attached no weight to it. We are told that, in fact, his invention, whatever it may have been, was not of his own, but of a partner, and that he was content to let it serve the purpose of doing credit to the name of an "invention of his." Selfish attention was certainly made an invention of such transitory value, and before the name of the inventor, and at a time when he was thus engaged in his most important studies, that it was made not the subject of a single line of notice in any of the numerous literary treatises of his time, and that he lived to see the publication of a history of science, in which he is mentioned as a person of no lower of scientific pursuits than the ablest original contributors whatever to the science of

pure mathematics. Science is indebted to him chiefly for his orreries and the observations of the transit of Venus. We are, therefore, of the opinion that the alleged invention of fluxions was little more than a "rumor set afloat by idle gossip." It serves to show us, however, in what unbounded admiration he was held by his countrymen.

At the age of nineteen Rittenhouse made the acquaintance of Thomas Barton, a talented young clergyman who had been a student at the University of Dublin. An intimate friendship grew up between them, which proved advantageous to the mental improvement of both. Barton was able to furnish Rittenhouse with some books suitable for his instruction. The burning zeal with which our young scientist pursued his studies appears from the following extract of a letter he wrote to Barton on September 20, 1756, at the age of twenty-four: "I have no health for a soldier [the country was then engaged in war], and as I have no expectation of serving my country in that way, I am spending my time in the old trifling manner, and am so taken with optics, that I do not know whether, if the enemy should invade this part of the country, as Archimedes was slain while making geometrical figures on the sand, so I should die making a telescope."

As a mechanic, Rittenhouse became celebrated for the extreme exactness and finish of his workmanship. Especially celebrated were his chronometer clocks. It was while thus engaged in the manufacture of clocks that he planned and executed an instrument which brought into play both his mechanical and mathematical skill. This instrument was the *orrery*. Concerning this wonderful mechanism, he wrote to Barton January 28, 1767, as follows: "I do not design a machine which will give the ignorant in astronomy a just view of the solar system, but would rather astonish the skilful and curious observer by a most accurate correspondence between the situations and motions of our little representatives of our heavenly bodies and the situations and motions of those bodies themselves. I would have my orrery really useful by making it capable of informing us truly of the astronomical phenomena for any particular point of time, which I do not find that any orrery yet made can do." It was, indeed, intended to be a sort of a perpetual astronomical almanac, in which the results, instead of being exhibited in tables, were to be actually exhibited to the eye. His orrery greatly exceeded all others in precision. It attracted very general attention among well-informed persons, and the Legislature of Pennsylvania, in appreciation of the talents of Rittenhouse, voted that the sum of three hundred pounds be given to him.

There arose a lively competition between different colleges in this country for the possession of this orrery. While the College of Philadelphia was negotiating for its purchase, a committee from the College of New Jersey went to examine it, and concluded to buy it at once; and thus, much to the chagrin of Dr. William Smith, Princeton bore off the palm from Philadelphia in obtaining possession of the first orrery con-



structed by Rittenhouse. He afterwards made another one for the Philadelphia College. The author of *The Vision of Columbus*, a poem first published in 1787, alludes to the Rittenhouse orrery in Philadelphia and the mass of people crowding to the college hall to see it, in the following lines (Book VII):

See the sage Rittenhouse, with ardent eye,  
Lift the long tube and pierce the starry sky;  
Clear in his view the circling systems roll,  
And broader splendours gild the central pole.  
He marks what laws th' eccentric wand'ers bind,  
Copies Creation in his forming mind,  
And bids, beneath his hand, in semblance rise,  
With mimic orbs, the labours of the skies.  
There wond'ring crowds with raptur'd eye behold  
The spangled heav'ns their mystic maze unfold;  
While each glad sage his splendid hall shall grace,  
With all the spheres that cleave th' ethereal space.

In August, 1768, Rittenhouse was appointed by the American Philosophical Society in Philadelphia as one of a committee to observe the transit of Venus on June 3d of the following year. A temporary observatory was built by him for the purpose near his residence at Norriton. Dr. William Smith aided him in procuring suitable instruments, and the preliminary arrangements were made with most scrupulous care. The approaching phenomenon was one of great scientific importance. Only two transits of Venus had been observed before his time, and of these, the first, in 1639, had been seen by only two persons. These transits happen so seldom that there cannot be more than two in one century, and in some centuries none at all. But the transits of Venus are the best means we have for determining the parallax of the sun. At the approach of the transit, Rittenhouse and his assistants in this observation, Dr. William Smith and Mr. Lukens, then surveyor-general of Pennsylvania, awaited the contacts in silence and anxiety. The observations were a success, and established for Rittenhouse the reputation of an exact and careful astronomer. The transit was observed in Boston by Professor Winthrop, and in Providence by Benjamin West, at almost all the observatories in Europe, and in various other parts of the globe. During the transit Rittenhouse saw one phenomenon which escaped the notice of all other astronomers. When the planet had advanced about half of its diameter upon the sun, that part of the edge of the planet which was off the sun's disc appeared dimmed, so that the outline of the entire planet could be seen. But a complete circle of light around Venus would indicate that more than half of Venus is illuminated. This can happen, as far as we know, only when the rays of light are refracted by an atmosphere. Hence, it would follow from the observations of Rittenhouse that Venus is surrounded, like the earth, by an atmosphere. But this appearance of a ring of light was not confirmed by other astronomers, and the state-

ment of Rittenhouse excited no attention for nearly a century, until his observation was, at last, confirmed by other astronomers.

An important invention made by Rittenhouse is that of the "collimator," "a device for obtaining a meridian mark without going far away; it has lately come back from Germany, where it was re-invented."<sup>\*</sup>

The reputation which Rittenhouse had now acquired as an astronomer attracted the attention of the Government, and he was employed in several important geodetic operations. In 1779 he was named one of the commissioners for adjusting a territorial dispute between the States of Pennsylvania and Virginia; in 1786 he was employed in fixing the line which separates Pennsylvania from the State of New York, and in the following year he assisted in determining the boundary between New York and Massachusetts. In 1791 he was chosen successor of Dr. Franklin in the presidency of the American Philosophical Society. All his scientific communications were made to that society and published in its Transactions.

Rittenhouse came to be looked up to by his countrymen as an astronomer equalled by few and surpassed by none of his contemporaries. Listen, if you please, to Thomas Jefferson's estimate of him. In answer to the assertion of Abbé Raynal that "America had not yet produced one good poet, one able mathematician, one man of genius in a single art or a single science," Jefferson says: "When we shall have existed as a people as long as the Greeks did before they produced a Homer, the Romans a Virgil, the French a Racine and Voltaire, the English a Shakespeare and Milton, should this reproach be still true, we will inquire from what unfriendly causes it has proceeded, that the other countries of Europe and quarters of the earth shall not have inscribed any name in the roll of poets. • • • In war we have produced a Washington, whose memory will be adored while liberty shall have votaries, whose name shall triumph over time, and will in future ages assume its just station among the most celebrated worthies of the world. • • • In physics we have produced a Franklin, than whom no one of the present age has made more important discoveries, nor has enriched philosophy with more, or more ingenious, solutions of the phenomena of nature. *We have supposed Mr. Rittenhouse second to no astronomer living; that in genius he must be the first, because he is self-taught.* As an artist he has exhibited as great a proof of mechanical genius as the world has ever produced. He has not indeed made a world; but he has by imitation approached nearer its Maker than any man who has lived from the creation to this day."<sup>†</sup>

Such was Jefferson's estimate of Rittenhouse. James Renwick says that "he [Rittenhouse] had shown himself the equal in point of learning and skill as an observer to any practical astronomer then living." Dr. Bush, in his eulogy, exclaims: "What a mind was here! Without

<sup>\*</sup>The Development of Astronomy in the United States, by Prof. T. H. Safford, p. 8.

<sup>†</sup>Jefferson's Notes on Virginia.

literary friends or society, and with but two or three books, he became, before he had reached his four-and-twentieth year, the rival of two of the greatest mathematicians in Europe!"

If we estimate Rittenhouse by what he *might have done* had he had a more rugged physical constitution and better facilities for self-development; had he had an observatory at his disposal such as those of his great contemporaries, Maskelyne and William Herschel in England, Lalande and Count Cassini in France, Tobias Mayer in Germany, then the above estimates may be correct. But if our astronomer be judged by the original contributions which, under existing adverse circumstances, he actually *did* make to astronomy and mathematics, then it must be admitted that he can not be placed in the foremost rank of astronomers then living. Friends will judge him by what *he might have done*; the world at large will judge him by what he *actually accomplished*. Our greatest indebtedness to Rittenhouse lies not in the original contributions he made to science, but rather in the interest which he aroused in astronomical pursuits, and in the diffusion of scientific knowledge in the New World which resulted from his efforts.

One who enjoyed, in his day, the reputation of being a "great mathematician," was Thomas Godfrey, of Philadelphia. He was a glazier by trade. Having met accidentally with a mathematical book, he became so delighted with the study that by his own unaided perseverance he mastered every book he could get on the subject. He pursued the study of Latin in order that he might read Newton's *Principia*. Optics and astronomy became his favorite studies, and the exercise of his thoughts led him in 1730 to conceive an improvement of the quadrant. In 1732 a description of his invention was sent to Dr. Hadley in England. Meantime, in 1731, Hadley had made a communication to the Royal Society of London, describing an improvement of the quadrant similar to that of Godfrey. The claims of both parties were afterwards investigated by the Royal Society, and both were entitled to the honor of invention. The instrument is still called "Hadley's quadrant," though of the two Godfrey was the first inventor. Afterwards it appeared that both had been anticipated in their invention by Newton.

Some of the personal characteristics of Godfrey are known to us through the writings of Benjamin Franklin. "I continued to board with Godfrey, who lived in part of my house with his wife and children, and had a school of the shop for his glazier's business, though he worked but little, being always absorbed in mathematics." In the autumn of 1727 Franklin turned most of his ingenious acquaintances into a club for mutual improvement, called *Leisure*. It met Friday evenings. "One of their first members of our Leisur," says Franklin, "was Thomas Godfrey, a self-taught mathematician, great in his way, and afterwards inventor of that instrument now called Hadley's Quadrant. But he knew little of the world, and was not a pleasing companion, as, like most great mathematicians I have met with, he expected universal precision in

everything said, and was forever denying and distinguishing upon trifles, to the disturbance of all conversation."

This assertion of Franklin that all mathematicians he had met were insufferable from their trifling and captious spirit, has been extensively quoted by opponents of the mathematical sciences. It was quoted by Goethe, and afterwards by Sir William Hamilton, the metaphysician, when he was engaged in a controversy with Whewell, the celebrated author of the *History of the Inductive Sciences*, on the educational value of mathematical studies. Hamilton attempted to prove the startling proposition that the study of mathematics not only possessed no educational value, but was actually injurious to the mind. He must have experienced exquisite pleasure in finding that Franklin, the greatest physical philosopher of America, had made a statement to the effect that all mathematicians he had met were "forever denying and distinguishing upon trifles."

We shall not speak of this controversy, except to protest against any general conclusion being drawn from Franklin's experience of the captiousness of mathematicians. Take, for examples, David Rittenhouse and Nathaniel Bowditch, who were early American mathematicians, and, like Godfrey, self-taught men. Though Franklin's statement may be true in case of Thomas Godfrey, it is most positively unjust and false when applied to the other two scholars. The biographers of David Rittenhouse are unanimous and explicit in their assertion that in private and social life he exhibited all those mild and amiable virtues by which it is adorned. As to Nathaniel Bowditch, of whom we shall speak at length later on, we have the reliable testimony of numerous writers that he was a man remarkable for his social virtues, modest and attractive manners, and Franklinian common sense.

Mention should be made here of Benjamin Banneker, the self-taught "negro astronomer and philosopher," born in Maryland, who became noted in his neighborhood as an expert in the solution of difficult problems, and who, with the use of Mayer's Tables, Ferguson's *Astronomy*, and Leadbeater's *Lunar Tables*, made creditable progress in astronomy, and calculated several almanacs. His first almanac was for the year 1792. The publishers speak of it as "having met the approbation of several of the most distinguished astronomers in America, particularly the celebrated Rittenhouse." Banneker sent a copy to Mr. Jefferson, then Secretary of State, who said in his reply, "I have taken the liberty of sending your almanac to Monsieur de Condorcet, secretary of the Academy of Sciences at Paris, and member of the Philanthropic Society, because I considered it a document to which your whole color had a right for their justification against the doubts which have been entertained of them."\* Banneker was invited by Andrew Ellicott to accompany "the Commissioners to run the lines of the District of Columbia" upon their mission.

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\* *History of the Negro Race in America*, by George W. Williams, p. 396.

## II.

### INFLUX OF ENGLISH MATHEMATICS, 1776-1820.

The Revolutionary War bore down so heavily upon the educational work in both elementary and higher institutions, that many of them, for a time, actually closed their doors. The majority of students and professors of Harvard and Yale were in the Army, or were in some other way rendering aid to the national cause. The buildings of Nassau (Princeton) College were for a time used as barracks. The business of Columbia College in New York was almost entirely broken up. The professors and students of Rutgers College at New Brunswick, N. J., were sometimes compelled by the presence of the enemy to pursue their academical studies at a distance from New Brunswick. The operations of Brown University in Providence, R. I., were discontinued during part of the war, the college building being occupied by the militia and the troops of Rochambeau. At William and Mary College the exercises were suspended in 1781 for about a year, and the building was occupied at different times by both British and American troops. The walls of the college were "alternately shaken by the thunder of the cannon at Yorktown and by the triumphant shouts of the noble bands who had fought and conquered in the name of American Independence." Academies and primary schools were either deserted or taught by women and white-haired men too old to fight. That the philosophic pursuits of scientific societies should have sunk very low is not surprising. Fifteen years elapsed between the publication of the first and second volumes of the Transactions of the American Philosophical Society in Philadelphia.

In spite of the financial depression and poverty which existed immediately after the war, much attention was paid to education. While in 1776 there existed in the colonies only seven colleges, the number was increased to nineteen before the close of the eighteenth century. Academies and grammar schools were established, and a large number of text books were put through the press. Even during the war the printing press sent out an occasional school-book. Thus, in 1778, while the war was raging most fiercely, an edition of Dilworth's spelling book was printed, which contained in its preface the following patriotic passage: "At the beginning of the contest between the Tyrant and the States, it was boasted by our unnatural enemy, that, if nothing more, they could at least shut up our ports by their navy and prevent the importa-

tion of books and paper, so that in a few years we should sink down into barbarity and ignorance, and be fit companions for the Indians, our neighbors to the westward." These words, printed at the darkest period of the Revolutionary War, disclose a spirit far from submissive. The colonists were not quite ready to sink down into barbarity and ignorance.) During the twenty-five years after the Declaration of Independence, more real progress was made in education than in the entire century preceding. Between 1776 and 1815 a large number of books on elementary and a few on higher mathematics were published in America. Many of them were reprints of English works, while others were compilations by American writers, modelled after English patterns. French and German authors were almost unknown. We may therefore call this the period of the "Influx of English Mathematics" into the United States. What little mathematics was studied in the colonies before the Revolution was, to be sure, gotten chiefly from English sources, but the scientific currents thither were then so very feeble and slow that we can hardly speak of an "influx."

#### ELEMENTARY SCHOOLS.

It is a significant fact that of the arithmetics used before the Revolution, but one work in the English language was written by an American author. It is equally significant that with the close of the great struggle for liberty, there began a period of activity in the production of new school-books. The second book devoted exclusively to arithmetic, compiled by an American author, and printed in the English language, was the *New and Complete System of Arithmetic* by Nicholas Pike, (Newburyport, 1788.)\*

Nicholas Pike (1743-1819) was a native of New Hampshire, graduated at Harvard College in 1766, and was for many years a teacher and afterward a magistrate at Newburyport in Massachusetts. His arithmetic received the approbation of the presidents and professors of the leading New England colleges. A recommendation from Harvard professors contains the following timely remark: "We are happy to see so useful an American production, which, if it should meet with the encouragement it deserves, among the inhabitants of the United States, will save much money in the country, which would otherwise be sent to

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\* It appears that Greenwood's Arithmetic, published nearly sixty years previously, was at this time not known to exist. Pike's Arithmetic was called the *first* American work of its kind. Dr. Artemas Martin has sent the writer the American Antiquarian, (Vol. IV, No. 12, New York, May, 1888) giving an account of Pike's book. It gives a letter written by George Washington at Mount Vernon, June 20, 1783, to Nicholas Pike, in which the former politely acknowledges the receipt of a copy of Pike's Arithmetic. We quote from the letter the following passage:

"Its merits being established by the approbation of competent judges, I flatter myself that the idea of its being an American production and the *first of the kind* which has appeared, will induce every patriotic and liberal character to give it all the countenance and patronage in his power."

Europe, for publications of this kind." Pike's arithmetic passed through many editions, was long the standard mathematical manual in New England schools, and formed the basis for other arithmetics. It was a very extensive and complete book for that time. A large proportion of the rules were given without demonstration, while some were proved algebraically. In addition to the subjects ordinarily found in arithmetics, it contained logarithms, trigonometry, algebra, and conic sections, but these latter subjects were so briefly treated as to possess little value. After the appearance of Webber's, Day's, and Farrar's Mathematics for colleges, which elaborated these subjects at greater length, they were finally omitted in the fourth edition of Pike's Arithmetic, in 1822.

In 1788, when the first edition appeared, English money was still the prevalent medium of exchange in the United States. To be sure, Federal money was adopted by Congress as early as 1786, but previous to 1794 there was no United States coin of the denomination of a dollar. It was merely the money of account, based upon the Spanish dollar, which had long been in use in this country. Congress passed a law organizing a mint in 1792, but permitting the circulation of foreign coins for three years, by which time it was believed the new coinage would be ready in sufficient amount. When dollars and cents began to replace pounds and shillings, it became desirable that the Federal currency be explained in arithmetics and taught in schools. In consequence of this, the sterling notation was changed to Federal in the third edition of Pike's arithmetic, which was brought out in Boston in 1808 by Nathaniel Lord. Similar changes were made in other arithmetics.\*

Down to the year 1800, the only arithmetic written by an American, which enjoyed wide spread and prolonged popular favor, was the one of Nicholas Pike. In 1800 appeared a second successful arithmetic, The Schoolmaster's Assistant, by Nathan Daboll, a teacher in New London

\*Curiously enough, even after Pike's Arithmetic there appeared in Philadelphia the *Practical Principles of the Art of Teaching*, by Thomas Simonson. This book, as well as the *Practical Principles of the Science of Numbers* (Philadelphia, 1794), by the same author, enjoyed great popular success. In 1795, this *Treatise on Arithmetic* in English was translated by Benjamin Webb (Boston, 1799), as well as George Peck (Albany, 1808). In 1801, a *New Assistant*, abridged by Benjamin Daboll, and revised by Peterson (Philadelphia, 1796), had a rather limited circulation. Nathaniel Lord's *Arithmetic* (Boston, 1792), enjoyed better success. After having given a text-book of New York for a few years, Vinnall at last became well acquainted with the Boston authorities. He is said to have been employed by the Boston School Committee. In 1800, Lord and Vinnall wrote an arithmetic, *Practical Principles of the Art of Teaching*, which enjoyed local reputation. Somewhat later, in 1801, appeared the *Practical Principles of the Art of Teaching*, by F. S. Johnson, a teacher in Hartford for several years a teacher, and afterward a member of the House of Representatives.

Other arithmetics published previously to the year 1800 include the names of several other hypothetical and obscure volumes, which, after an ephemeral reputation,

(born 1750 and died 1818). This work passed through numerous editions. Though Daboll had to compete with Pike's *Abridged Arithmetic* and with the celebrated *Scholar's Arithmetic* of Daniel Adams, it nevertheless acquired an extensive popularity. The expression, "according to Daboll," came to be a synonym for "mathematical correctness." It pushed aside the less favorite works. The main element of popularity of Daboll's *School-master's Assistant* lay in the fact that it introduced Federal money immediately after the addition of whole numbers, and showed how to find the value of goods therein immediately after simple multiplication. This arrangement, says the author, may be of great advantage to many who perhaps will not have an opportunity to learn fractions. Decimal fractions were wisely made to precede vulgar fractions. In the "Recollections" by Peter Parley, of the town of Ridgefield, Conn., are found the following interesting remarks: "We were taught arithmetic in Daboll, then a new book, and which, being adapted to our measures of length, weight, and currency, was a prodigious leap over the head of poor old Dilworth, whose rules and examples were modelled upon English customs. In consequence of the general use of Dilworth in our schools for perhaps a century, pounds, shillings, and pence were classical, and dollars and cents vulgar for several succeeding generations. 'I would not give a penny for it' was genteel; 'I would not give a cent for it' was plebeian."

Since the adherence to pounds and shillings came to be offensive to the people of the young republic, Mr. Hawley, in 1803, undertook to revise the work and alter all the problems to Federal currency. He called the new work "*Dilworth's Federal Calculator*," but after this change the book was so completely different from the original that the use of Dilworth's name in the title seemed hardly justifiable. Be that as it may, the *Federal Calculator* was not a success.

At the beginning of the nineteenth century there were three "great arithmeticians" in America, namely, Nicholas Pike, Nathan Daboll, and

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passed into forgetfulness, never to be resurrected to memory except by the curiosity of some inquiring lovers of "forgotten lore." To the above names we add: *The American Tutor's Assistant*, by John Todd, Philadelphia, third edition, 1797; *Arithmetic* by Zachariah Jess, Philadelphia, 1797; *American Arithmetic*, by David Cook, New Haven, Conn., 1799; *The Usher*, comprising arithmetic in whole numbers, Federal money, mensuration, surveying, etc., by Ezekiel Little, Exeter, 1799; *Usher's Arithmetic*, abridged, by Ezekiel Little, 1804; *The American Accountant*, by Chauncy Lee, Lansingburg, 1797; *The American Accountant*, by William Milne, New York, 1797, in which, instead of the answers to the problems, which were usually given, the author gave the remainders, after casting out the nines from the answers. A curious little volume is the following: "*The Young Gentleman's and Lady's Assistant*, containing Geography, Natural Philosophy, Rhetoric, Miscellaneous, to which is added a short and complete system of Practical Arithmetic, wherein the money of the United States of America is rendered easy to the perception of youth. The whole divided into small sections for the convenience of schools, by Donald Fraser, author of the *Columbian Monitor*, New York, 1796."



Daniel Adams. Having noticed the first two, we shall briefly speak of the third. Daniel Adams published in 1801 the *Scholar's Arithmetic*, a work which in point of merit towers far above the mass of contemporary school-books. Adams was a native of Massachusetts, graduated at Dartmouth College in 1797, and then became teacher, physician, and editor. He taught school in Boston from 1806 to 1813, then removed to New Hampshire, where he afterward served as State Senator. Though engaged in various lines of thought, arithmetical studies were his favorite. He furnished the school-boys' satchels not only with the *Scholar's Arithmetic*, but also with the *Primary Arithmetic*, and, in 1827, with the *New Arithmetic*, which passed through numerous editions. The *New Arithmetic* differed from the *Scholar's Arithmetic* in being analytic instead of synthetic in treatment. The analytic or inductive method of teaching, introduced into Switzerland by Pestalozzi, was gaining ground rapidly in this country at the beginning of the second quarter of the present century.

Between 1800 and 1820, a large number of arithmetics sprang into existence. Most of them enjoyed only a mushroom popularity. Among the more successful of the new aspirants to arithmetical fame were the following: Jacob Willetts, of Poughkeepsie, N. Y., the author of the *Scholar's Arithmetic*, 1812; William Kinne, of Maine, who graduated at Yale in 1804, and subsequently became teacher in his native State and the author of *A Short System of Practical Arithmetic*, Hallowell, second edition, 1807; Michael Walsh, the author of *A New System of Mercantile Arithmetic*, adapted to the commerce of the United States, Newburyport, 1801; Stephen Pike, whose arithmetic was published in Philadelphia in 1813; Samuel Webber's *Arithmetic*, 1810, which was used chiefly by students preparing for Harvard.\*

Our list of arithmetics published during the first twenty years of this century is doubtless very imperfect. Of the larger number of publications, the great majority had only an ephemeral reputation. Excepting those of Pike, Adams, and Daboll, hardly any have survived the recollection even of the aged.

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\* Less well known were the following books: Jonathan Groat's *Guide to Practical Arithmetic*, 1802; Caleb Alexander's *New System of Arithmetic*, Albany, 1808; W. M. Feltz's *Arithmetical Magazine, or Mercantile Accountant*, New York, 1803; James Noyes's *Federal Arithmetic*, 1804; the *American School-master's Assistant*, by Jesse Griffiths, of Kentucky, Lexington, 1804; Samuel Temple's *System of Arithmetic or Federal Commerce*, Boston, 1804; the *Youth's Arithmetical Guide*, by Tandon, Adair, and Watson, Philadelphia, 1805; *Mathematical Manual for the Use of Se. Mar.*, 1806; one of Baltimore, containing arithmetic and algebra, by L. I. M. Chevrone, Baltimore, 1806; Kneber's *Arithmetic Made Easy for Children*, second edition, 1807; Butler's *Travelling Unmasked*, 1806; Robert Patterson's *Treatise on Arithmetic*, Philadelphia, 1810; Daniel Stanford's *Practical Arithmetic*, Boston, 1818; George Fenwick's *Arithmetical Essay*, Alexandria, 1810; *Compendium of Practical Arithmetic*, by George Clarkson, Boston, 1810; the *American Arithmetic*, by Oliver Welch of New Haven, 1810; the *Teacher's and Pupil's Assistant*, by Dale Tweed of northern New York, 1820; the *Arithmetic of Leonard Loomis*; *The Columbian Tutor's Assistant*, by D. M. Smith, Washington, 1819; *The First Lines of Arithmetic*, 1818, by De Wolf and

Between 1815 and 1820 a reform in mathematical teaching was inaugurated in this country. Foremost among the leaders in this new movement was John Farrar of Harvard, who translated into English for the use of colleges a number of French works. The French books of that time were far in advance of the English. This reform in the teaching of the more advanced mathematics was accompanied by a similar reform in arithmetical teaching. The new ideas of Pestalozzi were vigorously forcing their way from Switzerland to all parts of the civilized world. Among the earliest fruits they bore in this country were the *First Lessons in Arithmetic*, by Warren Colburn, 1821. This primer contained points of great excellence, and it had a sale such as no other arithmetic ever had before.

We do not now speak of these reforms, except simply for the purpose of marking the end of an old period and the beginning of a new one.

Having enumerated the text-books published in the United States after the Revolution and preceding the year 1820, we shall now briefly examine their contents. The leading characteristics which we observed in Dilworth's *School-master's Assistant*, are found to exist in the books of this period. The arithmetics of this time were little more than Pandora's boxes of ill-formed rules to be committed to memory. Reasoning was exiled from the realm of arithmetic, and memory was made to rule supreme. A science chiefly intended to cultivate the understanding was offered to the exercise merely of memory.

This banishment of demonstration and worship of memory did not, I am glad to say, originate in this country. As already remarked, it came from England. About the middle of the seventeenth century there arose in England the commercial school of arithmeticians. To this school, says De Morgan, "we owe the destruction of demonstrative arithmetic in this country, or rather the prevention of its growth. It never was much the habit of arithmeticians to prove their rules; and the very word *proof*, in that science, never came to mean more than a

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Brown, teachers in Hartford, Conn.: the *Arithmetic of Zachariah Jess of Delaware*(?); *The Scholar's Guide to Arithmetic*, by Plinckas Merrill of New Hampshire; *Collection of Arithmetical Tables*, Hartford, 1812; *Arithmetic Simplified*, 1818, by John J. White; and *The Youth's Guide*, by Mordecai Stewart, Baltimore, 1818; Rev. John White's *Mental Arithmetic*, Philadelphia, 1818; "*The American Youth: being a New and Complete Course of Introductory Mathematics: designed for the use of Private Students*, by Consider and John Sterry." Vol. 1, Providence.

Besides these American works there were a number of foreign books republished in this country. Among these are, *The Tutor's Guide*, by Charles Vye, London, 1770, which reached the thirteenth American edition in Philadelphia in 1806; *A Complete Treatise on Arithmetic*, by Charles Hutton, Edinburgh, 1802, first American edition, New York, 1810; *A System of Practical Arithmetic*, by Rev. J. Joice, London, 1816, and adapted to the commerce of the United States by J. Walker, Baltimore, 1819; *The Scholar's Guide to Arithmetic*, by John Bonnycastle, London, 1786, Philadelphia, 1818. These English books can hardly be said to have excelled our American arithmetics; nor did they attain to any remarkable success in the New World.

test of the correctness of a particular operation, by reversing the process, casting out the nines, or the like. As soon as attention was fairly diverted to arithmetic for commercial purposes alone, such rational application as had been handed down from the writers of the sixteenth century began to disappear, and was finally extinct in the work of Cocker or Hawkins, as I think I have shown reason for supposing it should be called. From this time began the finished school of teachers, whose pupils ask, when a question is given, what rule it is in, and run away, when they grow up, from any numerical statement, with the declaration that anything may be proved by figures—as it may, to them.\*

Such is the history of the commercial school of arithmeticians in England. In America this school became firmly established wherever arithmetic was taught. Thus the sins of the early English pedagogues were visited upon the children in England and America unto the third and fourth generations. As late as 1818, one of our American compilers of text-books, Daniel Staniford, actually stated in the preface, as a recommendation to his book, that “all mathematical demonstrations are purposely omitted, to clear illustrations of the rules by easy examples and such as tend to prepare the scholar for business.” Not only was this method adopted in practice, but even advocated in theory. In both English and American arithmetics the rules were ill-arranged and disconnected. The pupil had to learn a dozen rules which might have been reduced conveniently to two or three principles. The continuity in the reasoning upon quantities expressed by integers and those expressed in common or decimal fractions was often so completely disguised that it became necessary to repeat the rules. Thus Dilworth and Bonnycastle give in their arithmetics three distinct rules, as follows:

Rule of three for integers.

Rule of three for vulgar fractions.

Rule of three for decimal fractions.

Nicholas Pike, Daniel Staniford, and John Vinall each give “Rules of interest,” and later on again “Rules of interest by decimals.” The result of this cumbersome rule system is that the scholar acquires the art of solving problems, provided he knows what rule it falls under, which is not always sure to be the case, for the first practical problem which will arise may be one requiring not one rule, but a combination of rules, which can therefore not be solved directly by the rules in his book. And yet he is fairly aground, for he has no mastery of principles, but is the mere slave of rules. Such a system of arithmetic has been very appropriately called *epitome*, since intellect goes for nothing throughout.

Among other features which characterize old American arithmetics are the following:

1. The total absence of exercises in mental arithmetic.

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\* *Arithmetic*, A. B. C., p. xxii.

(2) The meagre treatment of fractions. The number of exercises was so very limited that it was impossible for the student to acquire a mastery of fractions without additional drill.

(3) The process of "cancellation," which shortens calculations so much, was entirely unknown. Strange as it may seem, it is less than fifty years since cancellation was introduced into our arithmetics. One of the first books containing this process was published in 1840 by O. Tracy, in New Haven, entitled "A New System of Arithmetic, in which is explained and applied to practical purposes . . . the principle of cancelling. . . ."

(4) The system of numeration in early American arithmetics was not the French now generally used, but the English, in which the digits of a number are distributed in periods of six, and consequently proceed by millions. This method was first adopted by the Italians. Lucas de Burgo gives it in a work written in 1494. The method of reckoning by three places, as used in this country and on the Continent, seems to have originated with the Spanish.

(5) The subject which we now call proportion was then called the "Rule of Three." It was taught as a mere rule. The principle underlying it was ignored completely. That a proportion is the expression of the equality of two ratios was then not even hinted at. This fact goes to explain a point which otherwise would seem mysterious. If proportion is the equality of ratios, then why was not the usual symbol used to express that equality? Why were four dots used instead of the two horizontal lines? The answer seems to be that arithmeticians were not in the habit of thinking of a proportion as the *equality* of two ratios. A ratio was expressed by two dots, and the four dots were placed between the ratios simply to disjoint the terms, and to show that the second and third terms of the proportion were not in the same relation to each other as the first and second or third and fourth.

(6) The old arithmetics contain two methods of solving problems which are but rarely given in modern arithmetics. The methods I refer to were first used by the Hindoos on the far off banks of the Ganges, then borrowed from the Hindoos by the Arabs, who transmitted them to the Europeans. They are called the methods of "single position" and "double position." They teach us how to resolve questions by making one or two suppositions of false numbers, and then making corrections for the resulting errors.

We have seen that previous to the year 1820 a large number of arithmetics were published in this country; counting both American and foreign, there were to our knowledge over sixty different authors. Notwithstanding this fact, the majority of schools had an inadequate supply of arithmetics. In country schools especially, books were scarce and of a rather miscellaneous character, such as had been in families perhaps half a century. Johnnie Smith would, perhaps, bring to school a dilapidated copy of Dilworth's Arithmetic, which had been used once

by his father. His classmate, Billy Brown, would carry in his satchel a copy of Nicholas Pike's Abridged Arithmetic; the curly-headed Jimmy Jones would express his preference for Daboll's School-masters' Assistant, while the majority of the boys had no books at all. Whenever the supply of arithmetics was insufficient, manuscript books were resorted to. Arithmetics were sometimes covered with sheepskin, in the economical expectation that they might be made to lead not only one boy, but also his younger brothers in succession, to the golden science of numbers.

We have now spoken of the most popular arithmetics once used in this country. We have also briefly examined their contents. Our next task will be to ascertain, as far as possible, the manner in which arithmetic was taught in the school-room.

One of the first inquiries in this connection is regarding the quality of the teachers. The best teachers in elementary schools that our forefathers knew were young students who taught school for money to finish their courses in theology, medicine, or law. But this class of school-teachers was not large in early days. The representative school-masters of by-gone times were the itinerant school-masters. They were mostly foreigners. Their qualifications seemed to be the inability to earn anything in any other way. They were generally without families and had no fixed residence; they kept school first in one place and then in another, and wandered about homeless. Many were given to drinking and gambling. As a class, their knowledge was limited to the poorest elements. We are told that as late as 1822, in a town in the State of Connecticut, six out of fifteen applicants for positions as teachers were rejected because they did not understand notation and numeration of numbers. And yet these candidates came well recommended as having taught school acceptably in other towns for one, two, or three winters. If this story be true, then it will not seem strange to hear that it was a common practice for teachers in those early days to have their scholars "skip" fractions. This omission was justified on the ground that "fractions were rarely used in business," but there were generally other good and untold reasons for "skipping" the subject. There were few schools that carried the students beyond the rule of three or proportion.

We have seen the great defects in the old arithmetics. The statement of rules took the place of explanations and reasoning. If the school-masters had been competent and well trained, then the defects of bad books might have been remedied by skilful teaching, but the teaching was generally of the poorest kind. The truth of this assertion will be strikingly illustrated by a few examples. Joseph T. Buckingham tells us how, in 1790 or 1791, when he was about twelve years old, he began to learn arithmetic. I quote his exact words: "I told the master I wanted to learn to cipher. He set me a *sum* in simple ad-

dition, five columns of figures and six figures in each column. All the instruction he gave me was—add the figures in the first column, carry one for every ten, and set the overplus down under the column. I supposed he meant by the first column the left-hand column, but what he meant by carrying one for every ten was as much a mystery as Samson's riddle was to the Philistines. I worried my brains an hour or two, and showed the master the figures I had made. You may judge what the amount was when the columns were added from left to right. The master frowned and repeated his former instruction—add up the column *on the right*, carry one for every ten, and set down the remainder. Two or three afternoons (I did not go to school in the morning) were spent in this way when I begged to be excused from learning to cipher, and the old gentleman with whom I lived thought it was time wasted; and if I attended the school any further at that time reading, spelling, and a little writing were all that was taught." Next winter a more communicative teacher had the school, "and under him some progress was made in arithmetic, and I made tolerable acquisition in the first four rules, according to Dilworth's School-master's Assistant, of which the teacher and one of the oldest boys had a copy."

An experience similar to that of the writer just quoted was that of Warren Burton. In his book entitled "The District School as it was, by one who went to it," he says that simple addition was easy; "but there was one thing I could not understand—that carrying of tens. It was absolutely necessary, I perceived, in order to get the right answer, yet it was a mystery which that arithmetical oracle, our school-master, did not see fit to explain. It is possible that it was a mystery to him. Then came subtraction; the borrowing of ten was another unaccountable operation. The reason seemed to be then at the very bottom of the well of science; and there it remained for that winter, for no friendly bucket brought it up to my reach."

Mr. William B. Fowle gives an interesting account of John Tileston, who was chief writing-master in a reading school in Boston about the year 1790. It illustrates both the modes of teaching and the competency of teachers. One regulation of that school required the writing-master to teach "writing, arithmetic, and the branches usually taught in town schools, including vulgar and decimal fractions." Mr. Fowle speaks of Tileston as follows: \*

"He loved routine. • • • Printed arithmetics were not used in the Boston schools until after the writer left them, and the custom was for the master to write a problem or two in the manuscript of the pupil every other day. No boy was allowed to cipher till he was eleven years old, and writing and ciphering were never performed on the same day. Master Tileston had thus been taught by Master Proctor [his predecessor], and all the sums he set for his pupils were copied exactly from his

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\* Barnard's Journal, Vol. V, p. 336.

old manuscript. Any boy could copy the work from the manuscript of any other further advanced than himself, and the writer never heard of any explanation of any principle of arithmetic while he was at school. Indeed, the pupils believed that the master could not do the sums he set for them. • • • It is said that a boy who had done the sum set for him by Master Tileston carried it up, as usual, for examination. The old gentleman, as usual, took out his manuscript, compared the slate with it, and pronounced it wrong. The boy went to his seat and reviewed his work, but finding no error in it, returned to the desk, and asked Mr. Tileston to be good enough to examine the work, for he could find no error in it. This was too much to require of him. He growled, as his habit was when displeased, but he compared the sums again, and at last, with a triumphant smile, exclaimed, 'See here, you *nurly* (gnarly) wretch, you have got it, "If four tons of hay cost so much, what will seven tons cost?" when it should be, "If four tons of *English* hay cost so and so." Now go and do it all over again.' In this story, it may be remarked, some allowance must doubtless be made for the genius of the narrator.

The illustrations which have been given of the incompetency of teachers may appear to be exaggerations, and we certainly wish that for the good name of our early educators they were exaggerations. But the more we inquire into this subject and the more evidence we accumulate, the stronger the conviction becomes that most of them are not exaggerations, but fair samples of the teaching done by the average school master in elementary schools eighty or one hundred years ago.

In view of these facts, the most obstinate pessimist will be forced to admit that, within the last one hundred years, *progress* has been made. We have better books and abler teachers. Our methods of teaching arithmetic, though still imperfect, are a prodigious leap in advance of those of olden times. We boast of our material progress, and we certainly have great reason for doing so, but the progress in intellectual fields, and in education in particular, though less ostentatious, is none the less instructive.

Not without interest are the following two stanzas of a poem, entitled "A Country School," which was anonymously contributed to the New Hampshire Spy, and preserved in E. H. Smith's collection of American poems, 1794 :

And pray, Mr. Master, may I join?  
 Says Master, 'tis not your age, Ben,  
 Is this your age? Can't you tell?  
 Set all your letters parallel.  
 For there is a sum—'tis just a great—  
 Let's write it, Master, in I g'out!  
 Yes, 'tis the sum of the world—What's that Lark?  
 It isn't L, or, it's them boys.

Come Billy, read. What's that? That's A—  
*Sir, Jim has snatch'd my rule away—*  
 Return it, James. Here rule with this—  
 Billy, read on—that's crooked S.  
 Read in the spelling-book. Begin—  
*The boys are out. Then call them in—*  
*My nose bleeds, mayn't I get some ics,*  
*And hold it in my breeches? Yea.*  
 John, keep your seat. *My sum is more—*  
 Then do't again—divide by four,  
 By twelve, and twenty--mind the rule.  
 Now speak, Manasseh, and spell tool.  
 I can't. Well try. T, W, L.  
 Not wash'd your hands yet, booby, ha?  
 You had your orders yesterday.  
 Give me the ferule, hold your hand,  
 Oh! Oh! there—mind my next command.

## COLLEGES.

Before proceeding to the history of mathematics in higher institutions, we shall speak of American reprints of English mathematical works for colleges. First of all comes that good old Greek geometry of Euclid, of which the English made excellent translations. An edition of Euclid appeared in Worcester in 1784. This seems to be the earliest American edition. After the beginning of this century numerous editions of it were published. In 1803, Thomas and George Palmer, in Philadelphia, published Robert Simson's Euclid, together with the book of Euclid's Data, and the Elements of Plane and Spherical Trigonometry. The book was sold "at the book-stores in Philadelphia, Baltimore, Washington, Petersburg, and Norfolk."

Prof. S. Webber says, in his "Mathematics," that a good American edition of Playfair's Elements of Euclid, containing the first six books, with two books on the geometry of solids, was given by Mr. F. Nicholls, of Philadelphia, 1806. John D. Craig, teacher of mathematics in Baltimore, brought out an edition of Euclid in 1818. Robert Simson's Euclid was republished in Philadelphia in 1821; Playfair's in New York in 1819 and 1824, and in Philadelphia in 1826. In 1822 appeared the following work: "Euclid's Elements of Geometry, the first six books, to which are added the Elements of Plane and Spherical Trigonometry, a System of Conic Sections, Elements of Natural Philosophy as far as it relates to Astronomy, according to the Newtonian System, and Elements of Astronomy, with notes by Rev. John Allen, A. M., professor of mathematics at the University of Maryland." John D. Craig, in a notice of this book, says that Newton's work at this day is "almost a locked treasure among us," owing to the "scarcity of tracts giving the necessary preparatory knowledge." The object of this volume was to supply that want.

An English mathematician, whose works found their way across the ocean, was John Bonnycastle, professor of mathematics at the Royal



Military Academy, Woolwich. His *Introduction to Algebra* (London, 1782) was revised and edited in this country by James Ryan in 1822. Bouycastle was a teacher of rules rather than principles.

An English author well known in this country was Thomas Simpson. His *Treatise on Algebra* was published in Philadelphia in 1809. The second American from the eighth English edition, revised by David McClure, teacher of mathematics, came out in Philadelphia in 1821. As was frequently the case in those days, all demonstrations are here given by themselves in the manner of notes placed below a horizontal line on the page. They could be taken or omitted by teacher and pupil at pleasure, and were generally omitted. The author's explanations and demonstrations wanted simplicity, and we need not wonder if they were "looked upon, by some, as rather tending to throw new difficulties in the way of the learner than to the facilitating of his progress."

Another English algebra reprinted here was that of B. Bridge, fellow of St. Peter's College, Cambridge (second American edition from eleventh London, Philadelphia, 1839). We are informed that this work was introduced into the University of Pennsylvania, the Western University, Pittsburg, in Gummere's School at Burlington, the Friends' College at Haverford, and "a great number of the best schools in the United States." The *Three Conic Sections*, by the same author, was also patronized by some of our colleges. This subject was here treated purely synthetically, as was the case also in Robert Simson's *Conic Sections*, reprinted here in 1809 (?), and in all other English treatises of that time. Analytic methods, which proved so powerful in the hands of mathematicians on the Continent, were still underrated in England. The exclusive adherence to the synthetic method was due to an excessive worship of the views of Newton, who favored synthesis and employed it throughout his *Principia*.

We next mention Rev. Samuel Vince's *Fluxions*, printed in Philadelphia in 1812, or about twenty years after its first appearance in England. This seems to be the only work devoted exclusively to fluxions which was ever published in this country. Before the introduction of the Leibnitzian notation it was the text-book most generally used in our colleges, whenever fluxions were taught. An edition of Vince's *Astronomy* came out in Philadelphia in 1817. Of his other works, his "*Conic Sections*, as preparatory to the reading of Newton's *Principia*," was best known in America. Vince held the position of Plumian professor of astronomy and experimental philosophy in the University of Cambridge, England. His works generally lacked elegance, and failed to teach the more modern and improved forms of the mathematical science.

More prominent than any of the English authors here mentioned was Charles Hutton. His *Course of Mathematics* was edited in America by Robert Adams, and will be spoken of again later.

## HARVARD COLLEGE.

It has already been stated that the chair of mathematics and natural philosophy at Harvard was occupied from 1779 to 1788 by Rev. Samuel Williams, a pupil of John Winthrop. Williams wrote manuscript books on astronomy, mathematics, and philosophy. His mathematical manuscripts were probably studied in place of Ward's Mathematics, which had been used by his predecessor, John Winthrop. We possess hardly any information on the mathematical instruction during his time. The following is taken from the diary of a student who, in 1786, applied for admission to the third term of the Junior year: "Mr. Williams asked me if I had studied Euclid and arithmetic."\* This question having been answered, apparently, in the affirmative, he was admitted. From this it would seem that at that time Euclid and arithmetic were the only mathematical studies pursued previous to the close of the Junior year. The fourth year, says Amory, seems to have been principally occupied in the study of mathematics. From a quotation given by Amory, we infer that algebra was a college study at this time. It had probably been so during the last fifty years, but we possess no data from which this could be positively affirmed.

A ray of light upon the inner workings of the college is thrown by quotations from the diary of a student who was at Harvard in 1786. They show that the tutors of the college failed to command the esteem and respect of the students. Complaints were made that the *Greek* tutor was too young. "Before he took his second degree, which was last commencement, he was chosen a tutor of *mathematics*, in which he betrayed his ignorance often." Of another tutor it is remarked: "We recite this week to our own tutor in Gravesand's Experimental Philosophy. This gentleman is not much more popular than the rest of the tutors." Whoever has observed the freedom with which college boys speak of their instructors, knows that statements like these must be taken with some allowance. But the practice alluded to above, of selecting graduates who had excelled mainly in *classical studies* as tutors in *mathematics*, seems absurd. And yet it is well known that this custom was continued even in some of our best colleges down to a comparatively recent date. The objections to the custom which existed at Harvard previous to 1767 are still more obvious. In the early days of Harvard each tutor taught all branches to the class assigned to him, throughout the whole collegiate course. But in 1767 the rule was introduced that one tutor should not teach all the subjects, but only one subject, such as Greek; another tutor should have Latin; another mathematics, physics, natural philosophy, etc.

In 1789 Samuel Williams was succeeded in the professorship of mathematics and natural philosophy by Samuel Webber. Webber engaged, while a boy, in agricultural pursuits, and at the advanced age of

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\* "Old Cambridge and New," by Amory, in *North American Review*, Vol. 114, 1872.

twenty, in 1780, he entered Harvard College. After graduating he remained two years at the college, studying theology. He then held a tutorship till his appointment to the Hollis professorship, in which office he spent seventeen of the most important years of his life. In 1806 he was elected president of Harvard. He occupied this position till his death, in 1810. Henry Ware, in his eulogy of Webber, says: "As a scholar his attainments were substantial, embracing various branches of learning, but, mathematical science being most congenial to his taste and habits, he quitted his professorship for the presidency with reluctance. In communicating instruction, he united patience and facility with a thorough acquaintance with his subject." Edward Everett, who was a student at Harvard in Webber's time, makes a somewhat different estimate of him, saying that Webber was "reputed a sound mathematician of the old school, but rather too much given to routine."\* In another place, Everett speaks of him in the same way as "a person of tradition and routine." Judge Story says of him, "Professor Webber was modest, mild, and quiet, but unconquerably reserved and staid."<sup>†</sup>

In 1787, just before Samuel Webber was elected professor, the course of studies at Harvard was revised, with a view of raising the standard of learning. According to the new scheme, the classics "formed the principal study during the first three college years. The Freshmen were instructed, also, in rhetoric, the art of speaking, and *arithmetic*; the Sophomores in *algebra*, and *other branches of mathematics*; the Juniors in Livy, Doctridge's Lectures, and once a week, the Greek Testament; the Seniors in logic, metaphysics, and ethics."<sup>‡</sup>

The elementary mathematics were now studied in the first half of the college course instead of the second half. The Freshmen and Sophomores now began taking mathematics, though, we fear, only in ineffectual homeopathic doses. If arithmetic was begun in the Freshman year, then we may be sure that no very extensive course could have been given before the close of the Sophomore year. According to Judge Story, Saunderson's Algebra was used in 1795 or 1796. The original work of this blind mathematician was extensive, and in two volumes. The book used at Harvard consisted most likely of "Selected parts of Professor Saunderson's Elements of Algebra," published in one volume.<sup>§</sup>

W. Williams, a classmate of Channing's class of 1798,<sup>||</sup> says: "The Sophomores to give us Ethic to measure our strength. Many halted at the *quadrangle*. But Channing could go over clear at the first trial, as could some twelve or fifteen of us. This fact is stated to show that he had a model degree comprehended the abstrusities of mathematics,

\* Everett, *op. cit.* Vol. V. II, p. 199.

† Everett, *op. cit.* Vol. V. II, p. 199. Everett, *op. cit.*, 1860, Vol. I, p. 47.

‡ Everett, *op. cit.*, 1860, Vol. V. II, p. 200.

§ Thacker's *Ann.*, London, 1774.

though, to my apprehension, he excelled more decidedly in the Latin and Greek classics, and had a stronger inclination to polite literature."

We are, moreover, told of Channing: "He delighted, too, in geometry, and felt so rare a pleasure in the perception of its demonstrations that he took the fifth book of Euclid with him as an entertainment during one vacation." Such experiences are frequent with a student of advanced mathematics, but, unfortunately, too rare with pupils studying the elements.

If the course given by Quiney be supposed complete, then no mathematics was studied after the Sophomore year. This was probably not true; it certainly was not true ten years later. In 1797, at least some of the students pursued the more advanced mathematics during the latter part of the college course. A glimpse of light on this subject is thrown by the following quotation from the eulogy of John Pickering: "Great as was his enthusiasm for classical learning, he had in college as real a love for the study of mathematics, and highly distinguished himself in this department. Near the close of his Senior year he received the honor of a mathematical part, which appeared to give him more pleasure than all his other college honors. It afforded him an opportunity to manifest his profound scholarship in a manner most agreeable to his feelings. When he had delivered the corporation and overseers this part, containing solutions of problems by fluxions, he had the rare satisfaction to be told that one of them was more elegant than the solution of the great Simpson, who wrote a treatise on fluxions, in which the same problem was solved by him." It follows from this that provisions were made for the study of fluxions, at least for students who may have desired to study them.

Of the mathematical theses, written by Juniors and Seniors, which have been deposited in the Harvard Library, one hundred and thirty-three were written during the period from 1781 to 1807. Of these, the great majority are on the calculation and projection of eclipses. Surveying and the algebraic solution of problems receive also a large amount of attention. Of the one hundred and thirty-three theses only seven show by their titles that they contain "fluxionary problems." Their dates are, 1796, 1803 (two), 1804, and 1806 (three). After 1807, theses containing solutions of problems on fluxions are quite numerous. It may be of interest to state that John Farrar, the future professor of mathematics at Harvard, wrote in 1803 a thesis on the "Calculation and Projection of a Solar Eclipse." James Savage, the great authority on American genealogy, furnished a colored view of churches and college buildings; Everett, the diplomatist, a colored "*Templi Episcopalis Delineatio Perspectiva*." One thesis is on the "Calculation and Projection of a Solar Eclipse which took place in the year of the Crucifixion."\*

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\* Biographical Contributions of the Library of Harvard University, No. 32.

In 1802 the standard for admission to Harvard College was raised. In mathematics a knowledge of *Arithmetic* to the "Rule of Three" was required. Thus, in 1803, for the first time had it become necessary, according to regulations, for a boy to know something about arithmetic before he could enter Harvard. We surmise, however, that the requirements in arithmetic were very light, for we know from the diary of a student in the Freshman class in 1807 that arithmetic continued to be taught during the first year at college.\* After 1816 the whole of arithmetic was required for admission.

From the beginning of the nineteenth century on, we can get more definite information regarding the extent to which the mathematical studies were pursued. We need only examine the college text-books which began then to be printed in this country. The earliest mathematical text-books for colleges, written by an American author, are those of Samuel Webber. In 1801 were published in two volumes his "Mathematics, compiled from the best authors and intended to be a text-book of the course of private lectures on these sciences in the University of Cambridge." A second edition appeared 1808. These works were for a time almost exclusively used in New England colleges, but they finally gave place to translations from French works, executed by John Farrar, the successor of Webber in the professorship of mathematics.

Within two volumes, each of 460 pages and in large print, are embraced the following subjects: arithmetic, logarithms, algebra, geometry, plane trigonometry, mensuration of surfaces, mensuration of solids, gauging, heights and distances, surveying, navigation, conic sections, dialling, spherical geometry, and spherical trigonometry. Some idea of the extent to which each branch of mathematics was carried may be obtained, if we state that in Webber's works 124 pages were given to algebra, while Newcomb's *Algebra*, for instance, numbers 515 pages. The subject of conic sections was disposed of by Webber within 68 short pages, while Wentworth's *Analytic Geometry* covers 273 crowded pages. Comparatively much space was given by Webber to the applications of mathematics, such as gauging, heights and distances, surveying, navigation, and dialling. These practical subjects received much more attention than they are now receiving in the academic department in the majority of our colleges. Webber devotes only 47 pages to the important and extensive subject of geometry, and gives solutions of geometrical problems, but no theorems. This apparent neglect of the oldest and most beautiful of mathematical sciences is explained by Webber in the second edition of his work. In a foot-note (p. 339) he says that "At that time, as in Harvard College, Playfair's *Elements of Geometry*, containing the first six books of Euclid, with two books on the geometry of solids. Of this work Mr. F. Nichols, of Philadelphia, has given a good American edition" (1806). Webber's chapter on geometry was, therefore, included simply as a book with problems to accompany or

\* "Oxford Cambridge and New," by Amory, *North American Review*, Vol. 114, p. 114.

follow Euclid. If the course in elementary geometry was taught as here indicated, then it can hardly be said that this subject was neglected. Wherever Euclid is diligently studied, there geometry is not slighted.

Of John Farrar, the successor of Webber in the chair of mathematics and natural philosophy, we shall speak when we consider the influx of French mathematics into the United States.

Before leaving Harvard College we shall quote two short passages taken from the Harvard Lyceum. This journal was a publication by the students, and was the earliest of that kind at this college. The quotations about to be given disclose an effort to arouse interest among students in mathematical studies. In the first number, which appeared July 14, 1810, we read as follows: "The dry field of mathematics has brought forth most ingenious and elegant essays, most curious and entertaining problems. It is our wish to construct or select such questions in their various branches as may exercise the skill of our correspondents in their solution." This promise was not strictly kept. Mathematical enthusiasm could not be aroused quite so easily. There is to be found, to be sure, an ingenious essay on mathematical learning, presumably written by a Sophomore, in which we read: "Perhaps no science has been so universally decried by the overweeningly dull as the mathematics. Superficial dabblers in science, contented to float in doubts and chimeras, and unable to see the advantage of demonstrable truth, turn back before they have passed the narrow path which leads to the firm ground of mathematical certainty, and not willing to have others more successful than themselves, like the Jewish spies, they endeavor to deter them from the way by horrid stories of giant spectres in the promised land of demonstration, and scarcely a Caleb is found to render a true account of its beauties." But the Jewish spies were too eloquent, and there was no Caleb to furnish curious and entertaining problems.\*

#### YALE COLLEGE.

The chair of mathematics and natural philosophy at Yale College was established in 1770. Its first incumbent was Nehemiah Strong, who occupied it till 1781. In 1794 Josias Meigs was appointed to the position. Meigs was graduated at Yale in 1778, and served as tutor in mathematics, natural philosophy, and astronomy, from 1781 to 1784. In 1783 he was admitted to the bar, and some years later practiced in Bermuda. He appeared as a defender of American vessels that were captured by British privateers, and was, in consequence, tried for treason. He was professor at Yale until 1801, teaching mathematics, natural philosophy, and chemistry.† He then became president of the

\* The Harvard Book, by F. O. Vaille and H. A. Clark, Vol. II, p. 174.

† Prof. Benjamin Silliman (class of 1796) says, that on November 4, 1795, "Mr. Meigs heard the class recite at noon, as Dr. Dwight is out of town. Although Mr. Meigs is a very sensible man and very well calculated for the office which he now fills, still it is very easy to make a contrast between him and the president; but I am

University of Georgia. In 1812 he was appointed surveyor-general, and two years later, Commissioner of the General Land Office of the United States.

An important event at this period was the growth, among students, of a love for rhetoric and literature. English literature had hitherto been quite neglected. A taste for this study was excited by two young men, John Trumbull and Timothy Dwight, who were elected tutors in 1771. John Trumbull published, during the first year of his tutorship, a poem entitled the "Progress of Dulness," a satire, intended to expose the absurdities then prevailing in the system of college instruction. Ancient languages, mathematics, logic, and divinity received, in his opinion, an altogether disproportionate amount of time. In his poem, he introduces "Dick Hairbrain," a town fop, ridiculous in dress and empty of knowledge, and speaks of him as follows:

"What though in algebra, his station  
Was negative in each equation;  
Though in astronomy survey'd,  
His constant course was retrograde;  
O'er Newton's system though he sleeps,  
And hides his wits in dark eclipses!  
His talents proved of highest price  
At all the arts of card and dice;  
His genius turn'd with greatest skill,  
To whist, boe, cribbage, and quadrille,  
And taught, to every rival's shame,  
Each fine distinction of the game."

Timothy Dwight's love for literature did not entirely displace his interest for mathematics. On the contrary, we read in a life of him by his son that, "In addition to the customary mathematical studies, he carried them [his students] through spherics and fluxions, and went as far as any of them would accompany him into the Principia of Newton." "This, however, must have been a very rare thing," says President Woolsey. Dwight was tutor at the college for six years. To exhibit his continued interest in mathematics during that time we quote from the biography of him the following passage: "At a subsequent period, during his residence in college as a tutor, he engaged deeply in the study of the higher branches of the mathematics. Among the treatises on this science to which his attention was directed, was Newton's Principia, which he studied with the utmost care and attention, and demonstrated, in course of, but two of the propositions in that profound and difficult work. This difficult but delightful science, in which the mind is always guided by *certainty* in its discovery of truth, so fully engrossed his attention and his thoughts that, for a time, he

Dr. Woolsey, in his *Life of Timothy Dwight*, also says that a fellow-student of the president is one of the few persons in the world who have been able to read the Principia of Newton, and who form its study into a science. *Principia Mathematica*, London, 1776, International Series, vol. 1, p. 20.

lost even his relish for poetry; and it was not without difficulty that his fondness for it was recovered."

It will be remembered that the Mathematics of Ward had been introduced before the Revolution. In 1788 Nicholas Pike's arithmetic was adopted. Soon after 1801 Samuel Webber's Mathematics displaced the works previously used, excepting Euclid, which was presumably used during this whole period as the text-book in geometry. At about the beginning of this century the mathematical course was as follows: Freshmen, Webber's Mathematics; Sophomores, Webber's Mathematics and Euclid's Elements; Juniors, Enfield's Natural Philosophy and Astronomy, and Vince's Fluxions; Seniors, natural philosophy and astronomy.

A strong impetus to the study of mathematics in American colleges was given by Jeremiah Day. He graduated from Yale in 1795, became tutor there in 1798, and was elected professor of mathematics and natural philosophy in 1801. Feeble health prevented him from entering upon the duties of his professorship till 1803; but after that he continued in them till 1817, when he succeeded President Dwight in the presidency of the college. The chair was then given to Alexander Metcalf Fisher.

At the beginning of this century the great want of this country in the department of pure mathematics was adequate text-books. Professor Webber, of Harvard, was the first who attempted to supply this want. In those colleges in which a single system of mathematics had been adopted, preference was generally given to the "Mathematics" of Webber. But his compilation was rather imperfectly adapted to the purposes for which it was made. It was not sufficiently copious. Many topics, though strictly elementary and practically important, were passed over in silence. The method of treatment was too involved and the style not sufficiently clear to make the subject attractive to the young student. Accordingly Professor Day set himself to work to write a series of books which should supply more adequately the needs of American colleges. In 1814 appeared his Algebra, and his Mensuration of Superficies and Solids, in 1815 his Plane Trigonometry, and in 1817 his Navigation and Surveying. It was the original intention of the author to prepare also elementary treatises on conic sections, spherics, and fluxions, but on his elevation to the presidency he abandoned this design. His Algebra passed through numerous editions, the latest of which was issued in 1852, by the joint labors of himself and Professor Stanley.

Day's books are very elementary, and introduce the student by easy and gradual steps to the first principles of the respective branches. To us of to day, they appear too elementary for college use, but it must not be forgotten that at the time they were prepared, they were just what was needed to meet the demands of the times. Students applying for matriculation in those days had received very defective prepara-



tory training, especially in mathematics. With such unwrought material before him, it was natural for the teacher to show his preference for a text-book in which every process of development and reasoning was worked out patiently and minutely through all its successive steps. Day took for a model the diffuse manner of Euler and Lacroix, rather than the concise and abridged mode of the English writers. The great danger in this course is that no obstacles are left to be removed by the student through his own exertion. In the opinion of some teachers, Day has laid himself open to criticism by carrying the principle of making mathematics *easy* somewhat too far. It is no little praise for a book written at that time to say that, unlike most books of that period, Day's mathematics did not encourage the cramming of rules or the performing of operations blindly. On the contrary, the diligent student acquired from them a rational understanding of the subject.

Day's mathematics were at once everywhere received with eagerness. They were introduced in nearly all our colleges. Even at the end of a period of fifty years they still held their place in many of our schools. In view of these facts, "it may safely be said that the value of what their author did by means of them for the college and for the country at large, while holding the office of professor from 1803 to 1817, the time when he succeeded Dr. Dwight, was not surpassed by anything in science and literature which he did subsequently during his long term of office as president of the college."<sup>2</sup>

As a teacher and writer, President Day was distinguished for the simplicity and clearness of his methods of illustration. His kind-heartedness and urbanity of demeanor secured the love and respect both of friends and pupils.

He was succeeded in the chair of mathematics and natural philosophy by Alexander Metcalf Fisher, who held it until his death by drowning in 1822, at the shipwreck of the *Albion*, off the Irish coast. Fisher possessed extraordinary natural aptitudes for learning. He had prepared a full course of lectures in natural philosophy, both theoretical and experimental, which were marked for their copiousness and their exact adaptation to the purpose of instruction. His clear conception of what a text book should be is well shown in his review of Enfield's *Philosophy*.<sup>3</sup>

Regarding the course in natural philosophy at Yale, it may be remarked, that in 1788 Martin's *Philosophy*, which had gone out of print, was succeeded by Enfield's *Natural Philosophy*, first published in 1783. William Enfield was a prominent English dissenter. He preached in

<sup>2</sup> *Yale College: A Sketch of its History*, by William Kingsley, Vol. I, p. 115.

<sup>3</sup> *American Journal of Science*, Vol. III, 1821, p. 125. In Vol. V, p. 83, of the same journal, is an article by him, *On Maxima and Minima of Functions of Two Variable Quantities*. He contributed solutions to questions in the *American Monthly Magazine*, and in *Young's Mathematical Repository* (London). The fourth volume of the *Transactions of the American Academy of Arts and Sciences* contains observations by him on the comet of 1719 and calculations of its orbit.

Unitarian churches and published several volumes of sermons. Being engaged chiefly in theological studies, comparatively little attention was paid by him to the exact sciences. Nevertheless, he succeeded in compiling a work on natural philosophy which possessed elements of popularity and was used in our American colleges for four decennia. In 1820 appeared the third American edition of this work, which was then used by nearly all the seminaries of learning in New England, notwithstanding the fact that, excepting in electricity and magnetism and a few particulars in astronomy, it presented hardly any idea of the progress made in the different branches of philosophy since the period of Newton.

#### UNIVERSITY OF PENNSYLVANIA.

The University of Pennsylvania, which had such a remarkable growth under the administration of Dr. William Smith, before the Revolutionary War, had a comparatively small attendance of students after the war, and the college department is said to have been quite inferior to that of the leading American colleges of that time.

An educator who was long and prominently connected with this institution and whose activity was directed towards maintaining and raising its standard, was Robert Patterson, the elder. He was born in 1743 in Ireland, and at an early age showed a fondness for mathematics. In 1768 he emigrated to Philadelphia. He first taught school in Buckingham, and one of his first scholars was Andrew Ellicott, who afterward became celebrated for his mathematical knowledge displayed in the service of the United States.

About this time Maskelyne, the astronomer royal of England, compiled and published regularly the Nautical Almanac. This turned the attention of the principal navigators in American ports to the calculations of longitude from lunar observations, in which they were eager to obtain instruction. Patterson removed to Philadelphia, began giving instruction on this subject, and soon had for his scholars the most distinguished commanders who sailed from this port. Afterward he became principal of the Wilmington Academy, Delaware, and in 1779 was appointed professor of mathematics and natural philosophy at the University of Pennsylvania, which post he filled for thirty-five years. He was also elected vice-provost of that institution.\*

Robert Patterson communicated several scientific papers to the *Philosophical Transactions* (Vols. II, III, and IV), and was a frequent contributor of problems and solutions to mathematical journals. He edited James Ferguson's *Lectures on Mechanics* (1806), and also Ferguson's "*Astronomy explained upon Sir Isaac Newton's principles and made easy to those who have not studied mathematics*" (1809). Fer-

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\* *Transactions of American Philosophical Society*, Vol. II, New Series, *Obituary Notice of Robert Patterson, LL. D.*, late President of the American Philosophical Society.

guson was a celebrated lecturer on astronomy and mechanics in England, who contributed more than perhaps any other man there to the extension of physical science among all classes of society, but especially among that largest class whose circumstances preclude them from a regular course of scientific instruction. His influence was strongly felt even in this country, as is seen from the American editions by Robert Patterson of his astronomy and mechanics. Patterson wrote a small astronomy, entitled the *Newtonian System*, which was published in 1808. Ten years later he published an arithmetic, elaborated from his own written compends, previously used in the University. Though lucid and ingenious, this arithmetic was rather difficult for beginners, and never reached an extended circulation.

It is believed by many that mathematicians generally possess a strong memory for numbers. This was certainly not true of Patterson, for we are told that he could not remember even the number of his own house. He met this dilemma by devising a *mnemonic*, which was indeed worthy of a mathematician. The number of his residence was 285, which answered to the following conditions: "The second digit is the cube of the first, and the third the mean of the first two." It is to be wondered that, during some fit of intense abstraction, the learned professor did not pronounce 111 to be the number of his house, instead of 285; for 111 is a number satisfying the above conditions quite as well as 285.

When Robert Patterson resigned his position at the University of Pennsylvania in 1814, he was succeeded by his son, Robert M. Patterson. The latter was graduated at the University in 1804. After receiving the degree of M. D., in 1808, he pursued professional studies in Paris and London. In 1814 he was appointed professor of mathematics and natural philosophy, which office he filled until 1828, when he accepted the chair of natural philosophy at the University of Virginia. Robert M. Patterson published no mathematical books.

From 1828 to 1844 the chair of mathematics and natural philosophy was filled by Prof. Robert Adrain. The days of greatest activity of this most prominent teacher of mathematics were spent at other institutions, but we take this opportunity of introducing a sketch of his life.\*

Robert Adrain was born in Ireland. At the age of fifteen he lost both his parents, and thenceforward he supported himself by teaching. At the end of an old arithmetic he found the signs used in algebra. His curiosity becoming greatly excited to discover their meaning, he gave himself to the task, and at last he found out what they meant. In a short time he was able to resolve any sum in the arithmetic by algebra. Thenceforth he devoted himself with enthusiastic ardor to mathematics. He took part in the Irish rebellion of 1798, received a severe wound, and

\* This sketch is extracted from an article in the *Democratic Review*, 1844, Vol. XIV.

escaped to America. Immediately after his arrival he began teaching in New Jersey. After two or three years he became principal of the York County Academy in Pennsylvania. He then began contributing problems and solutions to the *Mathematical Correspondent*, a journal published in New York. This was the means of bringing his mathematical talents before the public. He obtained several prize medals, awarded for the best solutions.

In 1805 he moved to Reading, Pa., to take charge of the academy of that place. He started there a mathematical journal called the *Analyst*. The first number was published in Reading, but its typographical execution disappointed him so much that he employed a publisher at Philadelphia and incurred the extra expense of a republication. We shall speak of this journal again later.

In 1810 he was called to the professorship of mathematics and natural philosophy at Queen's (now Rutgers) College; and, in 1813, to the professorship of mathematics at Columbia College. In New York he became the center of attraction to those pursuing mathematical studies. A mathematical club was established, in which he shone as the great luminary among lesser lights. As a teacher, he had a most happy faculty of imparting instruction.

In 1826 the delicate state of his wife's health induced him to leave Columbia College in New York and to remove to the pure air and healthful breezes of the country near New Brunswick. About two years later he was induced to accept the professorship of mathematics at the University of Pennsylvania, a position which had been held at the beginning of the century by the well-known Robert Patterson. Adrain became also vice-provost of this institution.

He resigned this position in 1834 and returned to his country seat near New Brunswick, intending to pass his time with his family and in study. But he did not remain there long, for the habit of teaching had become too strong easily to be resisted. He moved to New York and taught in the grammar school connected with Columbia College until within three years of his death. At this time his mental faculties began very perceptibly to fail. He greatly lamented their decay, and, one day when a friend called in to see him, he had a volume of *La Place* on his lap endeavoring to read it. "Ah," said he, in a melancholy tone of voice, "this is a dead language to me now; once I could read *La Place*, but that time has gone by." He died in 1843.

Among American mathematicians of his day, Robert Adrain was excelled only by Nathaniel Bowditch. Of his many contributions to mathematical journals, one of the earliest was an essay published in 1804 in the *Mathematical Correspondent* on Diophantine analysis. This was the earliest attempt to introduce this analysis in America.

In 1808 Adrain began editing and publishing the *Analyst*, or *Mathematical Museum*. At that time he had not yet entered upon his career as college professor. The above periodical contained chiefly solutions

to mathematical questions proposed by the various contributors. It was a small, modest publication, which had only a very limited circulation in this country, and was unknown to foreign mathematicians. It lived, moreover, only a very short time, for only five numbers ever appeared. And yet, this apparently insignificant little journal, edited by a teacher at an ordinary academy, contained one article which was an original contribution of great value to mathematical science. It was, in fact, the first original work of any importance in pure mathematics that had been done in the United States. I refer to Robert Adrain's deduction of the Law of Probability of Error in Observation. The honor of the first statement in printed form of this law, commonly known as the Principle of Least Squares, is due to the celebrated French mathematician Legendre, who proposed it in 1805 as an advantageous method of adjusting observations. But upon Robert Adrain falls the honor of being the first to publish a demonstration of this law. He does not use the term "least squares," and seems to have been entirely unacquainted with the writings of Legendre. It follows, therefore, that not only the two deductions of this principle given by Adrain were original with him, but also the very principle itself.

We now give the history of this discovery by Adrain. Robert Patterson, of the University of Pennsylvania, proposed in the *Analyst* the following prize question: "In order to find the content of a piece of ground, . . . I measured with a common circumferentor and chain the bearings and lengths of its several sides, . . . but upon casting up the difference of the latitude and departure, I discovered . . . that some error had been contracted in taking the dimensions. Now, it is required to compute the area of this inclosure *on the most probable supposition* of this error." This was proposed in No. II of the *Analyst*, and after being a second time renewed as a prize question in No. III, it was at length, in No. IV, solved by a course of special reasoning by Nathaniel Bowditch, to whom Adrain awarded the prize of ten dollars. Immediately following Bowditch's special solution, the editor, Adrain, added his own solution of the following more difficult general problem: "Research concerning the probabilities of the errors which happen in making observations."\* This paper is of great historical interest, as containing the first deduction of the law of facility of error.

$$\varphi(x) = ce^{-hx^2}$$

$\varphi(x)$  being the probability of any error  $x$ , and  $c$  and  $h$  quantities de-

\**Analyst*, No. IV, pp. 21-27. Copies of this journal are very rare. No. IV is to be found in the Congressional Library in Washington; No. III and No. IV are in the Library of the American Philosophical Society, Philadelphia. Adrain's first proof of the Principle of Least Squares was re-published by Cleveland Abbe in the *American Journal of Science and Arts*, third series, 1871, pp. 411-415. Adrain's second proof was re-published by Mansfield Merriman in the *Transactions of the Connecticut Academy*, Vol. IV, 1857, p. 161; also in the *Analyst* (edited and published by J. E. Henderson, Des Moines, Iowa), Vol. IV, No. II, p. 33.

pending on the precision of the measurement. Adrain gives two proofs of this law. The first proof depends upon the "self-evident principle," as he calls it, that the true errors of measured quantities are proportional to the quantities themselves. The arbitrary nature of this assumption is pointed out by J. W. L. Glaisher in the *Memoirs of the Royal Astronomical Society*, Part II, vol. 39, 1871-72. "This," says Glaisher, "seems very far from being evident, not to say very far from being true, generally. One would expect a less relative error in a greater distance." Glaisher raises other objections to Adrain's first proof, and then pronounces it entirely inconclusive. Adrain's second proof, which is essentially the same as that given later by John Herschel, and usually called Herschel's proof, is likewise defective, as has been pointed out by Prof. Mansfield Merriman.

In order to place these criticisms on Adrain's two demonstrations in the proper light, it should be remarked here that the subject of which they treat is one of great difficulty. There has been great difference of opinion among leading mathematicians as to what *assumptions* regarding the nature of errors can be safely and legitimately made, and taken as a basis upon which to construct demonstrations and what ones should be rejected as being false or as demanding demonstration.

Subsequently to Adrain's paper, proofs were published by Gauss, La Place, Bessel, Ivory, John Herschel, Tait, Donkin, and others. Altogether, there appeared over a dozen distinct proofs, but all of these "contain, to say the least, some point of difficulty" (Glaisher). If, therefore, it be said that Adrain's proofs are inconclusive, we must remember that all other proofs hitherto given possess to a greater or less degree the same defect.

The number of the *Analyst* which gives Adrain's two proofs contains also the following applications of this method: (1) To find the most probable value of any quantity of which a number of direct measurements is given; (2) to find the most probable position of a point in space; (3) to correct dead-reckoning at sea; to correct the bearings and distances of a field survey.

At the close of the article he says: "I have applied the principles of this essay to the determination of the most probable value of the earth's ellipticity, etc., but want of room will not permit me to give the investigation at this time." It was published nine years later in Volume I, new series, of the *Transactions of the American Philosophical Society* (papers No. IV and XXVII). In the first paper he finds the earth's ellipticity to be  $\frac{1}{3}$ , instead of  $\frac{1}{3} + \frac{1}{4}$ , as was erroneously given by La Place (*La Mécanique Céleste*, Vol. III). In the second paper Adrain applies his rule to the evaluation of the mean diameter of the earth, which he finds to be 7,918.7.

His rule for correcting dead-reckoning at sea was adopted by Dr. Bowditch in his last edition of his *Practical Navigator*. Adrain's rule for correcting a survey is referred to by John Gummere in his *Survey-*

ing, as having been given and demonstrated by Bowditch and Adrain in the *Analyst*.

It thus appears that these rules of Adrain were made use of by at least some of the contemporary American mathematicians, but the principles from which these rules were deduced and the demonstrations of these principles appear to have excited little attention, and to have been soon forgotten. Foreign mathematicians never heard of Adrain's investigations on the subject of least squares until Adrain's first proof and extracts from other papers were reprinted by Cleveland Abbe in the *American Journal of Science and Arts* in 1871, or sixty years after their first publication in the *Analyst*. By a very strange oversight Cleveland Abbe does not even mention Adrain's second proof. The existence of this proof was pointed out, however, a few years later by Prof. Mansfield Merriman.

It is not much to the credit of American mathematicians that they should have permitted theoretical investigations of such great value to remain so long in obscurity. Let justice be done to Adrain, and let him be credited "with the independent invention and application of the most valuable arithmetical process that has been invoked to aid the progress of the exact sciences."

By the numerous elegant solutions which Adrain contributed to mathematical journals in this country, by his labors as teacher at Rutgers College, Columbia College, and the University of Pennsylvania, by his editions of Hutton's *Mathematics*, he contributed powerfully to the progress of mathematical studies in the United States. His first edition of Hutton's *Mathematics* was followed in 1812 by a second edition, and in 1822 by a third edition, in which he added an elementary treatise of sixty pages on descriptive geometry, "in which the principles and fundamental problems are given in a simple and easy manner." Other editions came out later. Adrain's edition of Hutton contained improvements in method and important corrections, the value of which was recognized by Mr. Hutton himself.

It may be well to call to mind at this place that Charles Hutton was professor of mathematics at the Royal Military Academy at Woolwich from 1773 to 1805. His course of mathematics was published in London, 1785-1801. In its day this work was doubtless the best of its kind in the English language. But at that time the English were far behind the French in the cultivation and teaching of mathematics. Hutton's course was plain and simple, but defective both in extent and analysis. The English works of that day generally contained rules without principles, and were decidedly inferior to the explanatory treatises of Lacroix and Bourdon, then used in France. Hutton's mathematics were used once at our own Military Academy at West Point, but were soon exchanged for the more analytical and copious treatises by French authors.

We close our remarks on Robert Adrain with the following quotation

from the Democratic Review of 1844, Vol. XIV: "He published little, because he was too severe a critic upon his own writings. He would revise and re-revise. It is said that while at Columbia, he had a treatise on the differential and integral calculus all written out and ready for the press; but upon giving it a further revision he became dissatisfied with some parts of it, and committed the whole to the flames." He left a number of manuscripts with commentaries on the *Mécanique Analytique* of Lagrange and the *Mécanique Céleste* of La Place.\*

#### COLLEGE OF NEW JERSEY (PRINCETON).

The College of New Jersey first opened at Elizabethtown, in 1746. Soon after, it was transferred to Newark, and in 1756 to Princeton. About seventy students moved from Newark to Princeton. The first president died after having been in office less than a year. His successor, Aaron Burr, the elder, held the post for ten years. He was an incessant worker and toiler. Though he was assisted by two tutors, he was himself teacher in Greek, logic, ontology, natural philosophy, and in the *calculation of eclipses*.† The courses in physics were illustrated by apparatus which had been obtained from Philadelphia. Popular lectures were delivered on the new electricity, and both president and students repeated Franklin's experiment on the influence of pressure on the boiling point, with glass globes of their own.

At first the college had no professors with fixed functions and permanent salaries. The instruction in classics and mathematics was committed to tutors who had lately graduated and were preparing for the ministry. They taught generally for but few years.

The first professor of mathematics and natural philosophy was William Churchill Houston. In early manhood he entered Princeton College, taught in the college grammar school, and was graduated in 1768. He was then appointed tutor, and, in 1771, elected professor. At the beginning of the Revolutionary War, he and Dr. Witherspoon were the only professors in the college. When Princeton was invaded in 1776, and the college was closed, he took active part in the war. As soon as quiet was restored at Princeton, he resumed his college duties. Soon after he was sent as a representative to Congress. He resigned his chair in 1783. In midst of his many duties, he had acquired a sufficient knowledge of law to be admitted to the bar. As a lawyer he soon acquired great reputation.

John Adams visited Princeton College in the opening days of the Revolution, when he was on his way to the Continental Congress. In his diary of August 26, 1774, he says: "Mr. Euston,‡ the professor of mathematics and natural philosophy, showed us the library; it is not large, but has some good books. He then lead us into the apparatus

\*For want of the necessary material, our sketch of the University of Pennsylvania will not be continued.

†The College Book, by Charles F. Richardson and Henry A. Clark, 1878, p. 97.

‡Mr. Houston was probably intended.



room; here we saw a most beautiful machine—an orrery or planetarium, constructed by Mr. Rittenhouse, of Philadelphia.” It will be remembered that both the University of Pennsylvania and Princeton College had been negotiating for the first orrery made by Rittenhouse, and that Princeton carried it off, much to the chagrin of Dr. William Smith, the president of the University of Pennsylvania.

The chair of mathematics and natural philosophy was filled two years after the resignation of Houston by the appointment of Ashbel Green. He was a native of New Jersey, and was graduated at Princeton College in 1783. He entered the ministry, and was professor for the two years succeeding 1785. Later, he became president of the institution.

Green's successor was Dr. Walter Minto, a Scotch mathematician of eminence. He was graduated at the University of Edinburgh, and then became tutor to the sons of George Johnstone, a member of Parliament. With them he travelled over much of Europe. In Pisa he became acquainted with Dr. Slop, the astronomer, and through him with the then novel application of the higher analysis to planetary motion. After returning to Scotland he became teacher of mathematics at Edinburgh. He came to the United States in 1786, and one year after became connected with Princeton College. Before coming to America he published a *Demonstration of the Path of the New Planet*; *Researches into Some Parts of the Theory of Planets*; and (with Lord Buchan) an *Account of the Life, Writings, and Inventions of Napier of Merchiston*.

While at Princeton, he delivered on the evening preceding the annual commencement of the year 1788 “an inaugural oration on the Progress and Importance of the Mathematical Sciences.” In this address he traces the history of mathematics down to the time of Newton, then directs his remarks to the students and trustees, emphasizing the importance of mathematical study. “The genius of Newton,” says he, “had he been born among the Indians, instead of discovering the laws of the universe, would have been limited to the improvement of the instruments of hunting, or to the construction of commodious wigwams.” At the time when this address was delivered he had been professor at Princeton about a year. Near the close of his oration he says: “It gives me a deal of pleasure, gentlemen, to have occasion to observe, in this public manner, that a considerable majority of those of you who have studied the mathematics under my direction have acquitted yourselves even better than my expectations, which, believe me, were very sanguine.” This inaugural address is his only publication while he was connected with Princeton College, but the college library contains some careful and curious MSS. on mathematical analysis written by him. Doctor Minto died at Princeton in 1796.

The mathematical duties were now assigned to Dr. John Maclean, a native of Scotland. In his day he was one of the most distinguished professors at Princeton, “the soul of the faculty.” His specialty was chemistry, which he had studied in Paris. He is said to have been one

of the first to reproduce in America the views of the new French school in chemistry. During seven years he was professor not only of chemistry, but also of natural history, mathematics, and natural philosophy; and after a short interval of four years, during which he was relieved from mathematical instruction by the appointment of Dr. Andrew Hunter to those duties, he again assumed charge of all the scientific instruction given to the students. He died in 1814.

From 1812 to 1817, Elijah Slack, a graduate of Princeton and a minister, was professor of natural philosophy and chemistry. He taught also mathematics. He was afterwards president of Cincinnati College. Henry Vethake taught mathematics from 1817 to 1821. In 1823, Mr. John Maclean, a young man of only twenty-three years, was made professor of mathematics.

It may here be remarked that in the library of Princeton College there is a folio volume of great interest and value, containing a copy of the first printed edition of Euclid's Elements in Greek (Basle, 1533); the commentary of Proclus on the First Book of Euclid (Basle, 1533); a twofold Latin translation (Basle, 1558)—one the Adelard-Campanus version, from the Arabic, the other the first translation into Latin from the Greek from Theon's Revision. This folio was once the property of Henry Billingsley, who three hundred years ago made the first translation of Euclid into English. By the examination of this folio, Dr. G. B. Halsted was able to show that the first English translation was made from the Greek, and not, as was formerly supposed, from any of the Arabic-Latin versions.\*

#### DARTMOUTH COLLEGE.

Dartmouth College, at Hanover, was chartered in 1769. Wheelock was the first president, and his first associate in instruction as tutor was Bezaleel Woodward, who had graduated at Yale in 1764, during the presidency of Clap, of whom it was said that in mathematics and natural philosophy "he was not equalled by more than one man in America."

Three of Dartmouth's first class were prepared for college at the "Indian Charity School" in Lebanon, and passed their first three years at Yale.

The facilities for acquiring a classical and scientific education appear to have been substantially the same at Dartmouth, at the outset, as in other American colleges of that period.† Some notion regarding the mathematical course at this college may be drawn from a letter written in 1770 by Nathan Teasdale, a learned and indefatigable teacher in eastern Connecticut, to Dr. Wheelock, the president of the college, introducing one of Teasdale's pupils, who applied for admission to the Senior year. The young man is described as "a genius somewhat

\*Note on the First English Euclid, *American Journal of Mathematics*, Vol. II, 1879.

†History of Dartmouth College, by B. P. Smith, p. 58.

better than common," who "had made excellent progress." "In arithmetic, vulgar and decimal, he is well versed. I have likewise taught him trigonometry, altimetry, longimetry, navigation, surveying, dialling, and gauging." "He likewise studied Whiston's Astronomy, all except the calculations." We are, probably, not far from the truth, if we conclude that the studies here enumerated were, in substance, the mathematics then studied at Dartmouth during the first three years.

The first twelve or thirteen years were years of very great trial for Dartmouth. The funds of the college were small and the students few. The Revolutionary War, though it did not interrupt the college exercises and disperse the students, must have diminished their number and affected their spirits. As in other localities, so in New Hampshire, the means of fitting for college were very imperfect and many of the college studies were inadequately pursued. "I remember," says Samuel Gilman Brown,\* "hearing one of the older graduates say that the first lesson of his class in mathematics was twenty pages in Euclid, the instructor remarking that he should require only the captions of the propositions, but if any doubted the truth of them he might read the demonstrations, though for his part his mind was perfectly satisfied." In stories like this, however, we must allow something for the genius of the narrator. This story, if not true, is certainly of the *ben trovato* sort. The requirements for admission to American colleges in those days were low, and the system of choosing the tutors, to whose care the Freshmen and Sophomore classes were entirely committed, was enough to destroy any chances of rectifying the errors of bad and insufficient preparation. Not unfrequently a fresh graduate who had excelled in classics alone, with very little taste for mathematics, would be chosen to fill a tutorial vacancy requiring him to teach mathematics, and *vice versa*. The bad consequences of such a system need not be dwelt upon here.

We see from the above that Euclid's geometry had been introduced in the early days of the college.

In 1790 the studies in college were as follows:†

"The Freshmen study the learned languages, the rules of speaking, and the elements of mathematics. The Sophomores attend to the languages, geography, logic, and mathematics. The Junior Sophisters, beside the languages, enter on natural and moral philosophy and composition. The Senior class compose in English and Latin; study metaphysics and the elements of natural and political law.

"The books used by the students are Lowth's English Grammar, Perry's Dictionary, *Pole's Arithmetic*, Guthrie's Geography, *Ward's Mathematics*, Atkinson's Epitome, *Hammond's Algebra*, *Martin's and Laplace's Natural Philosophy*, *Ferguson's Astronomy*, *Locke's Essay*,

\*Address before the Society of Alumni of Dartmouth College, 1855, p. 17.

†Barnes, *Journal of Education*, Vol. 28, 1870, International Series, Vol. I, p. 274, quoted by George Crosby from Lockup's History of New Hampshire, p. 296.

Montesquieu's *Spirit of Laws*, and Burlamaqui's *Natural and Political Law*." Hammond's *Algebra* was, we believe, an English work. In a catalogue of old, second-hand books we find, "Hammond, N., *Elements of Algebra in a new and easy method*, etc., 8vo. calf, 1742."

Of the early graduates of Dartmouth we would mention Daniel Adams, of the class of 1797, who furnished the schoolboy's satchel with the *Scholar's Arithmetic*, one of the best and most popular books of the time.

Another graduate somewhat distinguished in the mathematical line was John Hubbard, of the class of 1785. After studying theology, he became preceptor of the New Ipswich and Deerfield academies in Massachusetts. Afterwards he was judge of probate of Cheshire County, N. H. In 1804 he succeeded B. Woodward in the chair of mathematics and natural philosophy at Dartmouth, and filled it till his death in 1810. He published an *Oration*, *Rudiments of Geography*, *The American Reader*, and an essay on Music, but nothing on mathematics.

For twenty-three years, beginning in 1810, Ebenezer Adams was professor of mathematics and natural philosophy. In 1833 he was made professor emeritus.

For 1824 the mathematical studies as indicated in the catalogue of the college, was as follows: The Freshmen reviewed "arithmetick" and then studied algebra during the third term. No mathematical studies are given for the first two terms. The Sophomores were put down for six books of Euclid during the first term, plane trigonometry and its usual applications during the second term, and the completion of Euclid during the third term. The Juniors studied "conick" sections, and "spherick" geometry and trigonometry during the first term. The rest of the year was given to natural philosophy and astronomy. No mathematics in the last year.

In 1828 the college course was the same, but algebra to the end of simple equations was added to the terms for admission.

#### BOWDOIN COLLEGE.\*

When Bowdoin College was first organized, in 1802, the requirements for admission were an acquaintance with the "fundamental rules of arithmetic." Later, the expression "well-versed in arithmetic" is used. The first definite increase in the requirements did not occur till 1834, when part of algebra was added.

During the first three years of its existence the college had no regular professor of mathematics. But in 1805 the faculty was reinforced by the arrival of Parker Cleaveland, who six years before had graduated at Harvard first in his class and had been tutor in the university. The department of mathematics and natural philosophy was assigned to the

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\* For the greater part of the material used in writing this sketch, the writer is indebted to Prof. George T. Little of Bowdoin College.

youthful instructor. He remained at Bowdoin till his death in 1868 and earned for himself the enviable reputation of "Father of American mineralogy." Cleaveland was professor of mathematics from 1805 till 1835. One of the first books used was Michael Walsh's arithmetic, published at Newburyport in 1801. Webber's mathematics were taught for many years, until they were displaced by Farrar's "Cambridge mathematics."

The course in mathematics at the beginning and for twenty years after, was, in the Freshman year, arithmetic; Sophomore year, algebra, geometry, plane trigonometry, mensuration of surfaces and solids; Junior year, heights and distances, surveying, navigation, conic sections; Senior year, spherical geometry and trigonometry with application to astronomy. Algebra was gradually forced back to the Freshman year, but a part of the first term of this year was given to arithmetic as late as 1850.

In regard to the instruction in mathematics during the professorship of Parker Cleaveland, Professor Little sends us a copy of a letter from their oldest living graduate, the Rev. Dr. T. T. Stone, of the class of 1820. Says he: "Until near the close of our college life we had but one professor with the president and two tutors. Professor Cleaveland added to his duties as teacher of the natural sciences, in particular chemistry, mineralogy, and such as were contained in Enfield's Natural Philosophy, those of instructor in mathematics; although, I think, in the latter, that is, in mathematics, one of the tutors took part. Of the tutors who had most to do with this department, I remember Joseph Huntington Jones, afterward a Presbyterian minister in Philadelphia; Samuel Greene, well known in later days as minister of—I think, the Essex Street Church, Boston; and Asa Cummings, minister soon after of the First Church in North Yarmouth (the North since dropped off), and, later still, editor for many years of the Christian Mirror, and, if I am not mistaken, other tutors sometimes assisted in the department, as Mr. Newman, who from tutor became professor of the ancient languages in the spring of 1820, and afterward professor of rhetoric. It was he, unless my memory fails me, who took our class out to survey a piece of land to the north or south-west of what was then the college grounds, including probably the place where he and Professor Smyth and Professor Packard afterward lived—the only thing connected with the mathematics which I now remember outside of the recitations and the preparation, such as they were, for the regular exercises.

"Of the books then used, the first, and that which went with us, I am not sure but through the whole course from the Freshman year to the Senior, was Webber's Mathematics. The only other book of pure mathematics was Playfair's edition of Euclid, in which we went through so much, I now forget how much, as we had time of the six books which comprised a large part of the work. Added to this, Enfield's Philosophy took in, with its natural science, not a little of mathematical illustration.

"Of the methods of instruction, I have already stated that the only exception I remember to simple recitation was a single slight piece of surveying. We were required to study the prescribed lesson in the book, then to repeat it, not of course word for word, but distinctly, to the professor or tutor at the recitation; that was all."

#### GEORGETOWN COLLEGE.\*

Shortly after the close of the American Revolution the idea of establishing a college in Maryland, then the chief seat of the Catholic religion in this country, presented itself to the Rev. John Carroll, afterwards first Archbishop of Baltimore. Buildings were erected for this purpose in 1789, and a school first opened two years later. It rapidly grew into favor. Great attention was then paid to the classic languages, but only little to mathematics. Until 1806, when the college came into the hands of the Jesuits, the school was rather of preparatory grade. At this time a regular college course was arranged.

In 1807 Fr. James Wallace came to Georgetown. He had the classes here for two years. He was then sent to New York, where he taught in the "New York Literary Institution," an offshoot of Georgetown. While in New York he published a work on the Use of the Globes (New York, 1812). He returned to Georgetown in 1813 or 1814, and remained there until 1818, when he removed to Charleston, S. C. In 1821 his connection with the Society of Jesus was severed. After leaving Georgetown, he was for several years professor of mathematics in the South Carolina College. During his second stay at Georgetown he solved a problem proposed by the French Academy; as a reward they sent him many fine mathematical works. Professor Wallace was a man of ability, and a most patient and successful teacher.

Rev. Thomas C. Levins, born March 15, 1791, taught here from 1822 till 1825. He studied at Edinburgh, under Leslie, and then taught at Stonyhurst College, England. In 1825 he went to New York. Dr. Shea, in his Catholic Church in the United States (p. 403), states that Fr. Levins was one of the engineers of the Croton Aqueduct. He died in New York, May 6, 1843.

We have not been able to obtain more definite information on the early mathematical teaching at this college.

#### UNIVERSITY OF NORTH CAROLINA.

The first impulse towards the establishment of a university in North Carolina came, it seems, from the Scotch-Irish element occupying the midland belt of the State. "The early emigrants and settlers of this people brought their preachers, who also filled the office of teachers for the young. Tradition informs us that the most popular and best sustained of these nurseries of the young were located in the influential

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\* The above information is drawn mainly from a letter of Prof. J. F. Dawson, S. J., professor of physics and mechanics at Georgetown College.

counties of Iredell, Mecklenburgh, Guilford, and Orange. It was from these nurseries came the desire for higher education that formulated the article that decreed a State university. Doubtless the granting of a charter for William and Mary and for Harvard by the royal prerogative of the mother country, and the refusal of a like charter to Queen's College at Charlotte, in Mecklenburgh, during the colonial government, angered the *hornets*, fired the resentment of the Revolutionary patriots, and quickened their action in the blessings of liberty under the shield of the new-born Republic.\*

The doors of the university first opened for the admission of students in 1795. It was organized after the model of Princeton College, which, in turn, was patterned after the Scottish universities. Shortly after the University of North Carolina had begun, Charles W. Harris, a graduate of Princeton College, was elected to the professorship of mathematics. He occupied this chair for only one year. It had been his original purpose to study law, and after one year's experience in teaching he resigned in order to enter the legal profession. He was regarded as a man of considerable ability, but he died at the age of 33.

He was succeeded by Rev. Joseph Caldwell, who was also a graduate of Princeton and a native of New Jersey. He had been one year tutor at his *alma mater*. This remarkable man gave for nearly forty years his best energy to the interests of the university. In 1804 he was elected president, which office he retained till his death in 1833, with the exception of four years, from 1812 to 1816, during which period he retired voluntarily to the professorship of mathematics so as to secure more time for the study of theology.

At first the faculty was very small. In 1814 it consisted of "President Caldwell, Professor Bingham, and Tutor Henderson. Their college titles were 'Old Joe,' 'Old Sack,' and 'Little Dick.' 'Old Joe,' however, was only thirty years of age, and possessed . . . a formidable share of youthful activity."†

It is not generally known that Dr. Caldwell, in August, 1832, completed the first college observatory built in the United States. "It was," says Professor Love, "a brick structure about 25 feet high, and contained a transit, an altitude and azimuth instrument, a portable telescope, an astronomical clock with mercurial pendulum, and other minor apparatus, all of which he bought in London in 1824 from the best makers. For want of means and interest, however, the observatory, after Dr. Caldwell's death in 1835, was permitted to go down, and

\* Address by Paul C. Cameron in the inaugural proceedings at the University of North Carolina, June 3, 1875, p. 9. All the material for this sketch of mathematical teaching at that university has been furnished to the writer by Prof. James Lee Love, associate professor of mathematics at the University of North Carolina. Prof. Love has not only forwarded pamphlets, but has himself made careful investigation into the history of the institution, and kindly communicated his results to the writer.

† *Fifty Years Since*, by William Hooper, 1859, p. 10.

even the records of observations made there from 1832 to 1835 are not now known to exist."<sup>6</sup>

Professor Caldwell was a man of liberal and progressive views. He laid wisely the foundations of a great university in library and philosophical apparatus, as well as in the courses of study and in the men he gathered around him in his faculty. In remembrance of his long and untiring devotion to the institution a monument has been erected to him, by the alumni, in a grove surrounding the university.

When Caldwell went to Chapel Hill he found the college in a feeble state, nearly destitute of buildings, library, and apparatus; the students were very rough. We read of "unpleasant upheavals and volcanic eruptions" among them. Moreover, the bill of fare with which the minds of the students were obliged to content themselves was very meager. For admission in mathematics the elements of arithmetic were required from the beginning, in 1795, to 1835. In 1800 the requirement was "arithmetic as far as the rule of three;" in 1834, "arithmetic to square root." In our early arithmetics the rule of three was given for integers before fractions were touched upon, and we imagine that fractions were not required for admission, nor even any knowledge of integral arithmetic beyond the merest elements. The mathematical course offered in 1795 was as follows: (1) *Arithmetic* in a scientific manner; (2) *algebra*, and the application of algebra to geometry; (3) *Euclid's elements*; (4) *trigonometry* and its application to mensuration of heights and distances, of surfaces and solids, and to surveying and navigation; (5) *Conic sections*; (6) *the doctrine of the sphere and cylinder*; (7) *the projection of the sphere*; (8) *spherical trigonometry*; (9) *the doctrine of fluxions*; (10) *the doctrine of chances and annuities*. "The first four courses," says Professor Love, "were to be required for graduation. The remaining courses were to be taught if requested, but they were not requested."

The text-books used prior to 1808 cannot now be entirely determined. The first algebra used was probably Thomas Simpson's. It was certainly studied in 1803 and in 1815, and, perhaps, as late as 1826. The first geometry studied was Robert Simson's Euclid. On the application of trigonometry to mensuration, Bwing's Synopsis was used first—certainly as early as 1798. About 1810 President Caldwell prepared a course in geometry, based on Simson's Euclid. This was used by the students in manuscript, copies having been made and handed down from class to class. Hutton's Geometry was introduced in 1816. In 1822 Dr. Caldwell published his geometry, under the title, "A Compendious System of Elementary Geometry." It was used for some years. Bound with this book in one volume was a treatise on trigonometry. The plane trigonometry was prepared by himself; the spherical was Robert Simson's. No record has been found as to the trigonometry used prior to 1822, though Simson's was probably the one. It does not appear that

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<sup>6</sup> See also an article by Professor Love in the Nation for August 16, 1888.



the study and use of logarithms was introduced until 1811. Natural philosophy and astronomy were taught from the beginning. Ferguson's text was the one first used. In natural philosophy Nicholson's was used down to 1809, then Helsham's until 1816.

Dr. Caldwell was professor of mathematics from 1796 to 1817, but his activity extended in many other directions. He "taught mathematics, natural and moral philosophy, and did all the preaching." An interesting, though one-sided, picture of him as a teacher of geometry (about the year 1810) is given by William Hooper, one of the alumni: "There being but three teachers in college (president, professor of languages, and tutor), the Seniors and Juniors had but one recitation per day. The Juniors had their first taste of geometry, in a little elementary treatise, drawn up by Dr. Caldwell, in manuscript, and not then finished. Copies were to be had only by transcribing, and in process of time, they, of course, were swarming with errors. But this was a decided advantage to the Junior, who stuck to his text, without minding his diagram. For, if he happened to say the angle at *A* was equal to the angle at *B*, when in fact the diagram showed no angle at *B* at all, but one at *C*, if Dr. Caldwell corrected him, he had it always in his power to say, "Well, that was what I thought myself, but it ain't so in the book, and I thought you knew better than I." We may well suppose that the doctor was completely silenced by this unexpected application of the *argumentum ad hominem*. \* \* \* The Junior having safely got through with his mathematical recitation at eleven o'clock, was free till the next day at the same hour."\* It will be remembered, that the blackboard—that simple machine which doubles the teaching power of an instructor in geometry—was then unknown in America.

Fluxions were not taught at that time. William Hooper says in his humorous way, "As for chemistry and differential and integral calculus, and all that, we never heard of such hard things. They had not then crossed the Roanoke, nor did they appear among us till they were brought in by the northern barbarians about the year 1818."† These northern barbarians were Elisha Mitchell and Denison Olmsted. The latter introduced chemistry, mineralogy, and geology into the university. Dr. Mitchell was a New Englander. He graduated at Yale in the class of 1813 with Olmsted. He began teaching immediately after graduation, and in 1816 was appointed tutor at Yale. At the University of North Carolina he held the chair of mathematics from 1817 to 1825, and performed his duties with energy and success. When Dr. Olmsted was called to Yale, he assumed the vacant chair of chemistry, which position he filled with great credit until his death in 1857. He lost his life by falling over a precipice, in the darkness, while engaged in the scientific exploration of Mitchell's Peak in western North Carolina.

In 1818, after the arrival of Mitchell, spherical trigonometry, conic sections, and fluxions were introduced into the course of study leading

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\*Fifty Years Since, p. 23.

† Page 17 of his address.

to the degree of A. B. The course was as follows: *Freshman year*, arithmetic completed, algebra begun; *Sophomore year*, algebra completed, geometry; *Junior year*, plane trigonometry, logarithms, mensuration, navigation, spherical trigonometry, conic sections, fluxions; *Senior year*, astronomy, natural philosophy. It will be noticed that the course began now in the Freshman instead of the Sophomore year, as formerly. If it was faithfully carried out, then it must have been very creditable to the institution at that time. It remained nearly unchanged for seventeen years. As regards the text-books, it is probable that Simpson's Algebra was used by Mitchell; also Hutton's, and since 1822, Caldwell's Geometry and Trigonometry, and Vince's Conic Sections. In 1823, Day's work on mensuration was taught. No record has been found as to what text-books were used when fluxions were first introduced. It is possible, however, that Vince's and Hutton's were the ones. In astronomy Nicholson's was used for a long time. Cavallo's Natural Philosophy and Wood's Mechanics were used, the latter since 1822.

Mr. Paul C. Cameron gives an interesting reminiscence of B. F. Moore, a once prominent lawyer. "Often has he entertained me," says Cameron, "with the lights and shades of his college life; how grandly he marched through the recitations in the languages taught in the first and second years of his college life; how deep and suddenly he went *under* when he struck the mathematical course of the Junior year; how he wrote to his father and appealed to him to take him home and place him behind the plow. His father *refuses*, and tells him to make known his difficulties to his professor. He hands his father's letter to Dr. Mitchell, who invites him to his study and gives him instruction by the use of his knife and a piece of white pine, cutting for him blocks of mathematical figures, to be used in the demonstrations of his propositions. Turning the light on him in this way, he was enabled to continue his course with satisfaction."

#### UNIVERSITY OF SOUTH CAROLINA.\*

The South Carolina College threw open its doors for students in January, 1805. The first mathematical teacher at the college was Elisha Hammond of Massachusetts. He was a graduate of Dartmouth College, and when called to this position, was principal of Mt. Bethel Academy in Newberry, S. C. After one year's service he resigned and returned to the academy. Judge Evans, a student under him, says "His personal appearance and manners were very captivating, and his popularity for the period of his connection with the college was scarcely inferior to that of Dr. Maxey." Dr. Maxey was the president.

Rev. Joseph Caldwell, the father of the University of North Carolina, was then invited to the chair of mathematics, but he declined. Paul H. Perrault was elected to the place, but in 1811 he was removed for

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\* For the larger part of our information respecting this institution, we are indebted to Professor E. W. Davis, professor of mathematics and astronomy at the university.

"neglect of college duties." He is said to have been "well skilled in mathematics," but "wanting in that dignity which a Freshman would expect in a learned professor." After his separation from the college he was attached to the Army as a topographical engineer.

The mathematical professor for the next four years was George Blackburn. He was a graduate of Trinity College, Dublin. He taught in a military academy in Philadelphia; afterward he was teacher in Virginia, and was then called to the chair of mathematics and astronomy in William and Mary College. Thence he went to the South Carolina College. In 1812 he was employed by the State of South Carolina to run the boundary line between North and South Carolina. An old student says of him: "He was a man of quick and vigorous understanding, an able mathematician, and a most excellent instructor." Another: "Professor Blackburn was a first-rate mathematician; he taught mathematics as a science, and not as a matter of memory. From him I learned the demonstration of many difficult problems; and with his aid I understood much of that abstruse and difficult science as applied to natural philosophy and astronomy." He made students think. What detracted somewhat from his power as a teacher was his irritability.

In the better colleges of that day, the curriculum in mathematics embraced a short course on fluxions, or calculus. Though the plans of study included then about all the subjects pursued in the average American college of to-day, these subjects were not taught with the same thoroughness. Moreover, we are now teaching at least twice as much under each branch as was taught at the beginning of this century. In consequence of this, students of former times began the study of fluxions when, for lack of preparatory drill in lower branches, they were far less able to wrestle with the difficulties of the transcendental analysis than are our students of to-day. Professor Blackburn's teaching of the calculus, as narrated by M. La Borde, in his History of South Carolina College (p. 82), presents a picture of a Senior class vainly struggling with the intricacies of this subject. The class lost interest in the study and was very remiss in its attendance upon him, and those who did attend failed so completely in unraveling the mysteries of the transcendental analysis, as to force from the lips of the professor the remark, "that it might be that half of his class were very smart fellows, for he never saw them; but the half who attended his recitations were as laborious as oxen, but as stupid as asses." It need hardly be said that this was the cause of a students' rebellion.

After leaving the college, Professor Blackburn made latitude and longitude observations for the State map, under Governor Allston. Later he settled in Baltimore, where, with Dr. Jennings, he founded Astory College. His last days were spent in Columbia, S. C.

From 1815 to 1820, Christian Haackel, a Philadelphian and graduate of the University of Pennsylvania (class of 1810), was professor of mathematics. He took holy orders at St. Michael's, Charleston. His

main inducement to accept the chair was the chance to build up the Protestant Episcopal Church in Columbia. On leaving the college, he went to St. Paul's Church, Charleston.

The requirements for admission were, according to catalogue, at the beginning, "arithmetic, including proportion." This, most probably, did not include fractions. In 1836 the terms were "arithmetic, including fractions and the extraction of roots."

In the earliest course of mathematics at this college, the Freshmen took up arithmetic; the Sophomores, common and decimal fractions with extraction of roots; the Juniors, geometry, and theoretical and practical astronomy; the Seniors, exercises in higher mathematics as directed by the faculty. We are not certain that this curriculum embraced algebra. If taught then, it was a Senior study. Fractions were, it seems, not only not required for admission, but were not studied before the Sophomore year.

The course for the year 1811 was considerably stronger. The Freshmen were instructed in vulgar and decimal fractions, with extraction of roots; the Sophomores had lectures on algebra; the Juniors studied Hutton's course of mathematics; the Seniors had lectures by the "professor of mathematics, mechanical philosophy, and astronomy." From the anecdote told of Professor Blackburn, we know that at this time, or soon after, "calculus" (probably fluxions) was taught in the fourth year.

#### KENTUCKY UNIVERSITY.

About the year 1785 was opened in Lincoln County, Kentucky, a school called the Transylvania Seminary. Four years later it was moved to Lexington, Fayette County, where, in 1790, was held "the first public college commencement in the West of which we have any record." On January 1, 1799, the Transylvania Seminary and a similar school, called the Kentucky Academy, were united under the name of Transylvania University. The Transylvania University existed under this name until 1865, when it was merged in Kentucky University, and the consolidation has since been conducted under the name and charter of the latter.

Little has been done, in the past, to preserve the history of these institutions. Some of the records appear to have been lost, and those that are still extant give but little general information. The data on the very special subject of mathematical teaching are exceedingly meagre. The little information we are about to give was kindly furnished us by President Chas. Louis Loos, of Kentucky University.

The records of Transylvania University show that on September 16, 1799, "mathematics" was one of the subjects taught. On October 18, of the same year, the following books are mentioned in the mathematical course: *First year*, "Geography by Guthrie or Morse; algebra by Saunderson, Simson's Euclid, six books; trigonometry and mensuration, Gibson; Navigation, Patoun or Morse; Simson's conic sections."

*Second year.* "Natural philosophy and astronomy, Ferguson." These data are by no means destitute of interest. They show from what sources the young mathematician "in the West" drew his intellectual food, in early days. On October 26, 1799, Rev. James Blythe was elected professor of "science," which term was made to include mathematics. In 1803 the professor of science (J. Blythe) is called professor of mathematics and natural philosophy, and his duties were to teach "geography, arithmetic, algebra, geometry, surveying, navigation, conic sections, natural philosophy, and astronomy." In 1805 the course was the same as the one just given, except that geography, arithmetic, and surveying are not mentioned.

The entry in the records for March, 1816, gives the following course in mathematics:

*Freshmen*, first six books of Euclid, plane trigonometry, surveying, navigation, geography; *Juniors*, algebra as far as affected equations, spherical trigonometry, conic sections, natural philosophy, ancient geography; *Seniors*, astronomy.\* In 1817 Webber's mathematics is mentioned as a text-book.

#### THE UNITED STATES MILITARY ACADEMY.

The germinal idea of the United States Military Academy was put forth by George Washington, who felt, probably more than any one else, the necessity of having accomplished engineers in time of war. The Military Academy was established by Congress in 1802. The act was limited in its provisions and did not raise the academy above a military post, where the officers of engineers might give or receive instruction when not on other duty. The major of engineers was superintendent, the two captains were instructors, and the cadets were pupils.\*

The major was Jonathan Williams; the two captains were William H. Barron and Jared Mansfield.

Major Williams, in a report to the Government in 1808, gives us some notion of the early instruction at the academy. He says that "The major occasionally read lectures on fortifications, gave practical lessons in the field, and taught the use of instruments generally. The two captains taught mathematics, the one in the line of geometrical, the other in that of algebraical demonstrations." Mansfield taught also natural philosophy. He had previously been teacher of mathematics and navigation at New Haven, and then at Philadelphia. He had published "essays" of some originality on mathematics and physics. They fell under the notice of Thomas Jefferson, and were the means that led to his appointment by the President as captain of engineers for the very purpose of becoming teacher at West Point. But after one year's teaching he was appointed by Jefferson, in 1805, to establish new settlements and fortifications in the North-West Territory for the par-

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\* *U. S. Military Academy at West Point*, by Edward D. Mansfield, LL. D.

pose of public surveys. His position remained vacant until his return, after the War of 1812.

In 1806 Alden Partridge became assistant in mathematics. He was a native of Vermont, had entered Dartmouth College in 1802, but before completing his course became cadet at West Point.

Captain Barron was relieved in 1807 by Ferdinand R. Hassler, who continued there until 1810, when he resigned. The following year he was called to the United States Coast Survey. Hassler was a Swiss. It was again the keen eye of President Jefferson that recognized the talent and secured the services of this foreigner, who had shortly before landed on our shores. Hassler's teaching power must have been hampered somewhat by his limited acquaintance with the English language. While at West Point he began writing his "*Elements of Analytic Trigonometry*," published by him in 1826. It was written in French and then translated for publication by Professor Renwick. From its preface we take the following: "It was the desire of introducing into the course of mathematics at West Point the most useful mode of instruction in this branch that led me to the preparation of this work as early as the year 1807." Hassler was, no doubt, the first one to teach *analytic* trigonometry in this country—the first one to discard the old "line-system."

About the same time Christian Zoeller, also a Swiss, was made instructor in drawing. He was "an amiable man of no high attainments."

Down to the year 1812 the academy was in a chaotic condition. There was no regular corps of instructors, and no regular classes. There had been no continuous study of any subject except mathematics. Referring to Hassler, Major Williams says in his report of 1808, "During the last year a citizen of eminent talents as a mathematician has been employed as principal teacher," and "being the only teacher designated by the law, he is the only one that, exclusive of the corps of engineers, can be said to belong to the institution." In conclusion the major says: "In short, the Military Academy as it now stands is like a foundling, barely existing among the mountains, nurtured at a distance out of sight, and almost unknown to its legitimate parents."

In vain did Jefferson in 1808 and Madison in 1810 recommend to Congress the enlargement of the academy. It was not until the nation was roused by the shock of war that Congress began to act. In 1812 Congress made liberal appropriations and passed an act reorganizing the institution. The next five years are the formation period of the academy. The first reform to be accomplished was the placing of the instruction on a higher level. The first academic faculty was constituted as follows: Col. Jared Mansfield, professor of natural and experimental philosophy; Andrew Ellicott, professor of mathematics; Alden Partridge, professor of engineering; Christian Zoeller, professor of drawing. We see from this that Mansfield held now the same place as in 1804, and Partridge was promoted from assistant to the rank of professor.

Mansfield and Ellicott had long been in the service of the General Government and of State governments in the capacity of surveyors and astronomers, and had established a wide reputation for both their practical and theoretical knowledge of mathematics. But now they were old men, and their ideas were somewhat old-fashioned. The workings of this faculty were not altogether harmonious. Partridge, being strong-willed and eccentric, wanted to have everything his own way. He was removed from his place. The appointment of Major Sylvanus Thayer, in 1817, to the superintendency of the academy marks a new era in its history.

Some notion of the instruction in mathematics at West Point between 1812 and 1817 may be obtained from the following extract from the curriculum which, in 1816, received the official approval of the Secretary of War.

*Mathematics.*—A complete course of mathematics shall embrace the following branches, namely: The nature and construction of logarithms and the use of the tables; algebra, to include the solution of cubic equations, with all the preceding rules; geometry, to include plane and solid geometry, also ratios and proportions, and the construction of geometrical problems, application of algebra to geometry, practical geometry on the ground, mensuration of planes and solids; plane trigonometry, with its application to surveying and the mensuration of heights and distances; spherical trigonometry, with its application to the solution of spherical problems; the doctrine of infinite series; conic sections, with their application to projectiles; fluxions, to be taught at the option of the professor and student.\*

There was, however, no instruction in fluxions. E. D. Mansfield, in his historical sketch of the academy, does not include fluxions in the curriculum for 1816, but he remarks that calculus was added to the course a year or two later. The text book then in use was Hutton's *Mathematics*.

Thus far the cadets were admitted to the academy without entrance examinations, and poor results were reached. Many cadets were unfit by prior study for the subjects they had to pursue. Rank and assignment to the various army corps were not made to depend upon merit.\*

#### SELF-TAUGHT MATHEMATICIANS.

The foremost American mathematician of this time, like David Rittenhouse and Thomas Godfrey, had not enjoyed the privileges of a college education; like them, he was self-taught. We have reference to Nathaniel Bowditch.\*

\* *History of Bowditch*, by Charles F. Smith, and Henry A. Clark, p. 216.

\* *History of Bowditch*, by Charles F. Smith. *Mathematics of Nathaniel Bowditch*, by his son, Nathaniel Bowditch, 1848. I have followed his course on the Life and Character of Nathaniel Bowditch, by Alexander Young, Boston, 1847; from the eulogy by Professor Piercing, Boston, 1847; and from the eulogy by Judge Daniel A. White, Salem, 1848. A full list of Bowditch's mathematical papers may be found in the *Mathematical Monthly*, Vol. II.

It is instructive to study the history of his early life and to ascertain the influences under which his mind was formed. He was born at Salem, Mass., in 1773. His parents were poor, and he had often to content himself with a dinner consisting chiefly of potatoes, and at near approach of winter to continue wearing the thin garments of summer. After attending for a short time a dame's school near Salem, he entered Watson's school, which was the best school in Salem. It was wholly inadequate to furnish the ground-work and elements of a respectable education. He entered the school at the age of seven and remained there three years.

Bowditch early showed a great fondness for mathematics; but on account of his extreme youth his master refused to admit him to this study until he had procured from his father a special request to that effect. On one occasion he solved a problem in arithmetic which the instructor thought must be far above his comprehension. On being asked who had been doing the sum for him he answered, "Nobody—I did it myself." He was then accused of falsehood and treated with much severity.

When he was ten years old he left school to work in the shop of his father, who was a cooper. He received no regular instruction after leaving school, excepting a few lessons in book-keeping. He became soon after an apprentice to a ship-chandler, and afterward was clerk in a large mercantile establishment. It was during his apprenticeship that he disclosed that strong bent for mathematical studies. Every moment that he could snatch from the counter was given to the slate. When he was only fifteen years old he made an almanac for the year 1790, containing all the usual tables, calculations of the eclipses and other phenomena, and even the customary predictions of the weather.

When he was fourteen years old he one day got from an elder brother a vague account of a method of working out problems by *letters* instead of *figures*. This novelty excited his curiosity; he succeeded in borrowing an algebra, and "that night," says he, "I did not close my eyes." He read it, and read it again, and mastered its contents; and copied it out from beginning to end.

Subsequently he acquired access to an extensive scientific library of Dr. Richard Kirwan, an Irish scientist, which had been captured in the British channel by a privateer and sold to a society of gentlemen at Salem. This became the basis of the present Salem Atheneum. He found there the Philosophical Transactions of the Royal Society of London, from which he made full and minute abstracts of the mathematical papers contained in them. At this time he was too poor to buy books, and this was the only way in which he could manage to have them for convenient reference. The title page of one of these manuscript volumes states that it contains, with the next volume, "A complete collection of all the mathematical papers in the Philosophical Transactions; extracts from various encyclopedias; from the Memoirs of the Paris Academy;



a complete copy of Emerson's *Mechanics*; a copy of Hamilton's *Conics*; extracts from Gravesande's and Martin's *Philosophical Treatises*; from Bernoulli, etc., etc." What perseverance, what energy, what enthusiasm is displayed in this laborious work of copying!

Bowditch was very fond of books, but having no guide in the selection of them his reading was at first of the most miscellaneous character. Thus he read every article in Chambers' *Encyclopædia* from beginning to end. He secured a copy of Newton's *Principia*, but as it was published in Latin he began the study of that language that he might read that great work. By great perseverance he learned enough Latin to enable him to read any work of science in it. He afterward learned French for the purpose of having access to the treasures of French mathematical science, and at a late period of his life he acquired some knowledge of the German language. When twenty-one years of age he had read the immortal work of Newton, and there were few in his State who surpassed him in mathematical attainments.

Bowditch did not long remain in the situation of a merchant's clerk. His mathematical talent, in a town distinguished for enterprise, could not fail of being called into exercise in connection with the art of navigation. He became a practical navigator. Between 1795 and 1804 he was on five sea voyages, all under the command of Captain Henry Prince, of Salem.

The leisure of the long East India voyages, when the ship was lazily sweeping along under the steady impulse of the trade winds, afforded him fine opportunities for pursuing his mathematical studies, as well as for indulging his taste in general literature. The French mathematician Lacroix acknowledged to a young American that he was indebted to Mr. Bowditch for communicating many errors in his works, which he had discovered in these same long India voyages. It was his practice both when at home and when at sea to rise at a very early hour in the morning and pursue his studies. He was often seen on deck "walking rapidly and apparently in deep thought, when it was well understood by all on board that he was not to be disturbed, as we supposed he was solving some difficult problem, and when he darted below the conclusion was that he had got the idea; if he were in the fore part of the ship when the idea came to him, he would actually run to the cabin, and his countenance would give the expression that he had found a prize."

"He loved to study himself," says Captain Prince, "and he loved to see others study. He was always fond of teaching others. He would do anything if any one would show a disposition to learn. Hence," he adds, "all was harmony on board; all had a zeal for study; all were ambitious to learn." On one occasion two sailors were zealously disputing, in the hearing of the captain and supercargo, respecting sines and co sines. As a result of his teaching, the whole crew, yea, even the negro cook, acquired the knowledge of how to compute a lunar observation. When the captain once arrived at Maula, he was asked how he

contrived to find his way, in the face of a northeast monsoon, by mere dead reckoning. He replied, that "he had a crew of twelve men every one of whom could take and work a lunar observation as well for all practical purposes as Sir Isaac Newton himself, were he alive." During this conversation Bowditch sat "as modest as a maid, saying not a word, but holding his slate pencil in his mouth;" while another person remarked, that "there was more knowledge of navigation on board that ship than there ever was in all the vessels that have floated in Manila Bay.

At that period the common treatise on navigation was the well known work of Hamilton Moore, which had occasioned many a shipwreck, but which Bowditch, like other navigators, was obliged to use. He found it abounding with blunders and overrun with typographical errors. Of these last errors many thousands of more or less importance were corrected in the early revisions of the work. Bowditch published several editions of Moore's works under that author's name, but the whole book at length underwent so many changes and radical improvements as to justify him to take it out on his own name. This is the origin of Bowditch's *Practical Navigator*, the best book on navigation then in existence. The following particulars regarding the publication of this work have been handed down to us:

The first American edition was printed in 1801, but not published until 1802. The publisher, Mr. Blunt, took the work and a copy of Hamilton Moore, with all the errors marked, to England, called on the publishers of Hamilton Moore, and sold the printed copy of Bowditch on condition that the American edition should not be sold until June, 1802, to give them an opportunity to get theirs into the English market at the same time. The London edition was revised and newly arranged by Thomas Kirby, teacher of mathematics and nautical astronomy. It was recommended as an improvement on Bowditch, but it contained many errors. This gave occasion to a British writer, Andrew Mackay, who published a rival work on navigation, to make Dr. Bowditch's supposed inaccuracies a particular object of attack.\* This charge was emphatically repelled by Bowditch in the new edition of 1807.

From Harvard College Bowditch received the highest encouragement to pursue his scientific studies. In July, 1802, when his ship was wind-bound in Boston, he went to attend the commencement exercises at Harvard; and among the honorary degrees conferred, he thought he heard his own name announced as a master of arts; but it was not till congratulated by a friend that he became satisfied that his senses had not deceived him. He always spoke of this as one of the proudest days of his life, and amid all subsequent distinctions conferred upon him from foreign countries, he recurred to this with greatest pleasure.

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\* *Memoirs of American Academy of Arts and Science*, Vol. II, 1846, Eulogy on Bowditch, note C.

On quitting the sea, in 1803, he was appointed president of an insurance company in Salem, the duties of which he continued to discharge for twenty years, when he accepted the position of actuary of the Massachusetts Hospital Life Insurance Company in Boston. For many years he discharged the duties of this office with the greatest fidelity and skill.

He was several times solicited to accept positions in various literary institutions. In 1806 he was chosen to fill the Hollis Professorship of Mathematics at Harvard. He received from Thomas Jefferson the offer of the professorship of mathematics at the University of Virginia. Jefferson said in his letter: "We are satisfied we can get from no country a professor of higher qualifications than yourself for our mathematical department." In 1820 he was asked to permit his name to be presented to the President of the United States to fill a vacant chair at the U. S. Military Academy at West Point. Bowditch could not be persuaded to accept any of these positions.

The work for which Bowditch was for a long time exclusively known was his *Practical Navigator*. This gave him a wide-spread popularity among sea-faring people everywhere. Bowditch himself did not consider this work as one which would advance his scientific reputation. What established his celebrity as a man of science was not his *Practical Navigator*, but his translation, with a commentary, of the epoch-making work of Laplace, called the *Mécanique Céleste*.

Later on we shall speak of this translation at length. Bowditch contributed many articles to the American edition of Rees's *Cyclopædia*.

The question may be asked, how should Bowditch be ranked as a mathematician? In answer to this we may say, that he is acknowledged by all as having stood at the head of scientific men of this country, and to have contributed more to his country's reputation than any contemporary scientist. But a giant in Lilliput is not necessarily a giant in another country. Though a man of great energy and intellectual powers, he can not be pronounced a first class mathematician. He was a man of learning, but not a man of genius in the sense that Newton, Leibnitz, Gauss, Arch. Pascal, and Archimedes were men of genius. The estimate that Bowditch made of his own capacities and gifts was, in our opinion, accurate, fair, and just. He did not overrate his talents, nor did he, with assumed humility, purposely underrate his powers. He is reported as having once said, "People are very kind and polite, in mentioning me, in the same breath with Laplace, and blending my name with his. But they mistake both me and him; we are very different men. I trust I understand his works, and can supply his deficiencies, and record the successive advances of the science, and perhaps append some improvements. But Laplace was a genius, a discoverer, an inventor; and yet I hope I know as much about mathematics as Playfair!"

The career of Bowditch furnishes us with an excellent illustration of how much may be accomplished through indefatigable energy and per-

servance by a mind which, though naturally far above the average mind, is, nevertheless, lacking the powers of real genius.

A mathematician of considerable local reputation was Enoch Lewis (1776-1856). He was a native of Pennsylvania and a Quaker. In 1799 he became teacher of mathematics at the West Town Boarding School, established by the Society of Friends. He was the author of treatises on arithmetic, algebra, and trigonometry.

Under the tuition of Enoch Lewis, for six months, at the Friends' Boarding School at West Town, was John Gummere, who was then about twenty years old. Excepting in reading, writing, and arithmetic, he had received no instruction whatever up to that time. After teaching elementary schools for six years, he determined in 1814 to open a boarding school in Burlington. The following story characterizes the young man.\*

He determined to give courses of lectures in natural philosophy and chemistry, and proposed to his brother, who had joined him in the school, that he should take the latter. The brother replied that he had never opened a book on chemistry. "Neither have I," said John, "on natural philosophy." It was then objected that they could not obtain the appropriate instruments and apparatus in this country. "But we can get them," he said, "from London." It was suggested that they might fail in so making themselves masters of their respective subjects as to pursue them advantageously. "But we shall not fail," said he; "only determine and the thing is half done." An order was sent to London for apparatus, both philosophical and chemical, a better supply of which was provided for his institution (at an expense of several thousand dollars) than was to be found in any private institution in this country.

Gummere acquired considerable reputation as a teacher and writer. He was for over forty years teacher in Friends' schools in Pennsylvania and New Jersey. He once declined the proffered chair of mathematics at the University of Pennsylvania. He contributed astronomical papers to the American Philosophical Society. The most celebrated of his works was his *Surveying* (1814), which went through a large number of editions. It was more extensively known and more highly prized than any other work on surveying. His treatise on theoretical and practical astronomy was once used as a text-book at West Point and other leading scientific institutions. In preparing it he had greatly profited by French models.

Mention should be made here of the mathematical studies of Walter Folger, a lawyer, of Nantucket. They will throw light upon the kind of instruction which was then being given at our American ports, in night schools for navigators. After attending common schools, Folger studied land surveying, in which, without the least assistance, he became exceedingly skillful. "In the winter of 1782-83 he attended an

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\* *Memorials of the Life and Character of John Gummere*, by William J. Allison.

evening school in which he studied navigation, and readily acquainted himself with these branches. Nothing of a mathematical character seemed ever to present any difficulties to his mind. He mastered algebra and fluxions without assistance, and while in his teens he read Euclid as he would read a narrative, no problem arresting his progress: and yet, so little did he know of language, or of anything appertaining to it, that he had reached the years of manhood, as he often confessed, before he knew the definition of the word *grammar*.\*

"His father finally succeeded in obtaining for him a work of navigation, to which, for the first time, was appended Dr. Maskelyne's method of obtaining the longitude at sea by means of lunar distances. This delighted him, and at the age of eighteen, [when] prostrated with sickness, he familiarized himself with the problem, and the engagement so diverted his mind from his infirmities that he speedily regained his strength. He immediately applied all his influence to the encouragement of the use of this method among his fellow-townsmen, then universally engaged in the prosecution of whaling voyages. To numbers he gave personal instruction, and the first American ship-master who determined his longitude by lunar observations is said to have been one of his pupils." A similar school was held in Philadelphia by Robert Patterson.

#### SURVEYING OF GOVERNMENT LANDS.

In a new and growing country like ours it was only natural that the art of surveying should have been early cultivated. But to a surveyor some knowledge of the rudiments of geometry and trigonometry was indispensable. As early as 1761 there was published, or reprinted, in Philadelphia a work entitled, *Subtential Plane Trigonometry*, by Thomas Abel, presumably an English teacher. In 1785 there was reprinted in Philadelphia an edition of Robert Gibson's *Practical Surveying*, which first appeared in London in 1767. This enjoyed an extended circulation. In 1799 appeared in Wilmington the first popular American treatise on surveying, by Zachariah Jess, a teacher and practical surveyor, of Delaware. In the preface to Gunmire's *Treatise on Surveying* (1814) we read: "The works of Gibson and Jess are the only ones at present in general use. The former, though much the better of the two, is deficient in many respects." In 1796 was published in New York, *The Art of Surveying Made Easy*, by John Love, and at Litchfield, *An Accurate System of surveying*, by Samuel Moore. In 1806 Rev. Abel Flint published his *Geometry and Trigonometry, with a Treatise on Surveying*. Flint, educated at Yale in 1785, was tutor at Brown till 1790, afterward studied theology, and then became pastor at Hartford, Conn.

The publication of Gibson's *Surveying* in 1785 was very timely, for it was in this very year that Congress passed an ordinance specifying

\* A list of Members of the late Walter Folger, of Nantucket," by William Mitchell, in the *American Journal of Science and Arts*, second series, Vol. IX, No. 27, May, 1852.

that surveyors, as they were respectively qualified, should proceed to divide the western territory into townships of 6 miles square by lines running due north and south, and others crossing these at right angles as near as may be. Each township should be subdivided into lots of one mile square. This system was not universally approved, for it tended to delay the sale of public lands till they could be correctly measured. In the Madison Papers (Vol II, p. 640) we read that the Eastern States favored the plan adopted, while the Southern were "biased in favor of indiscriminate location." Kentucky and Tennessee adhered to the old plan of indiscriminate location. This occasioned so much litigation in those States that it has been said that as much money was annually expended there in land-title litigation as would defray their taxes for the support of the severest war. Lands surveyed by the United States, on the other hand, were comparatively without any legal difficulty. In fact, one great object of the Government system was the removal of all temptation to incur the curse pronounced by Moses on him "who removeth his neighbor's landmark." The corners of each section were carefully located by marked trees, whose species, diameter, distance, and bearing were entered upon the field-notes. If the marked tree at any one corner were destroyed, then its location could be determined from the other corners. Though a great improvement on previous modes of surveying, it is inaccurate and rude indeed as compared with the refined triangulation surveys now carried on by the United States Coast and Geodetic Survey.

Most conspicuous in the execution of the early Government surveys were Andrew Ellicott and Jared Mansfield. Ellicott was engaged in a large number of surveys. At various times he was appointed commissioner for marking the boundaries of Virginia, Pennsylvania, and New York; in 1789 he was selected by Washington to survey the land lying between Pennsylvania and Lake Erie; in 1790 he was employed, with his brother Joseph, in surveying and laying out the city of Washington; in 1792 he was made Surveyor-General of the United States; in 1796 he was appointed United States Commissioner, under the treaty of San Lorenzo el Real, to determine the boundary between the United States and the Spanish possessions on the south. It is stated that he sent observations to Delambre, of France, remarking that they were made by a "self-taught astronomer, and the only practical one now in the United States." This was after the death of David Rittenhouse.

More prominently connected with the survey of the North-West Territory than Ellicott was Jared Mansfield. He was a graduate of Yale College. In 1801 (?) he published *Essays, Mathematical and Physical*. From the perusal of his works alone the illustrious Thomas Jefferson was induced to bring him into public life. In 1803 he was appointed surveyor-general of the North-West Territory. His first work was to determine astronomically certain lines of latitude and the principal meridians on which the surveys were to proceed. To carry out this

work astronomical instruments were needed. President Jefferson ordered the purchase from London of a transit instrument, a telescope, an astronomical clock, and a sextant. The first principal meridian began at the mouth of the Great Miami; the second at a point 5 miles south-west of the confluence of Little Blue River with the Ohio; the third at the confluence of the Ohio and the Mississippi Rivers; the fourth at the junction of the Illinois and Mississippi; the fifth at the mouth of the Arkansas River. A large number of other meridians, or "base-lines," have since been established.\*

In view of the fact that our Government has had, all in all, nearly 3,000,000 square miles of land to sell or to otherwise dispose of, and that the sale had always to be preceded by a survey, it must be evident that there was a demand for surveyors. They could earn a comparatively easy subsistence while a student of pure mathematics might have gone a begging for a living. About 1816 a friend of Comte in this country warned that French mathematician and philosopher against the purely practical spirit that prevailed in this new country, and against coming here, by saying: "If Lagrange were to come to the United States he could only earn his livelihood by turning surveyor."

#### MATHEMATICAL JOURNALS.

The number of mathematical journals published in this country since the beginning of this century is much greater than one might suppose. A full historical sketch of these periodicals has been given by Dr. David S. Hart in the *Analyst* (Vol. II, pp. 131-8, 1875), and we shall make free use of his valuable article.

The oldest mathematical journal in America was the *Mathematical Correspondent*. It was established by gentlemen in New York and other cities, who had long felt the want of a periodical which should do for America what the *Ladies' Diary* had done for England. George Baron was editor in chief. It was to be issued quarterly. The first number was issued in New York City on May 1, 1804. Only eight numbers ever appeared. An essay in this magazine on Diophantine analysis, by Robert Adams, was the first attempt to introduce the study of this subject in America.

The main cause of the discontinuance of the journal lies in the prejudice which the editors, who were of Hibernian descent, entertained against American authors. A contributor, who called himself "A Rabbit," was permitted by the editors to sneer at several works written by American authors, such as Shepherd, Pike, Walsh, and others. The editors themselves also spoke in the most contemptuous manner of Col. Jared Mansfield, the superintendent of the Military Academy at West Point. A notice advertised on the cover of No. 2 of the *Correspondent* a

\* For a full account of the early surveys see *Niles's Register*, Vol. XII, pp. 27, 47, Vol. XVI, p. 12.

lecture delivered by him in New York, which contains, as he says, "a complete refutation of the false and spurious principles ignorantly imposed on the public in the new American Practical Navigator, written by N. Bowditch." The sub-editors endorsed the above. But some of these attacks, especially "A Rabbit's," seem to have created trouble, and on p. 154 the editor says: "'A Rabbit' will not in any future number be permitted to propose questions concerning the blunders of stupid Shepherds; we had rather soar aloft with the eagle than waddle in the mud with the goose." For some hidden reason, Baron resigned the editorship. Many of the subscribers neglected to pay, and the paper soon died out.

The next periodical was the *Analyst*, or *Mathematical Museum*, edited by Robert Adrain. The first number was published in Philadelphia in 1808. Five numbers only appeared. We have spoken of this periodical at some length when we wrote about Robert Adrain. It contained the valuable original work of Adrain on the Law of Probability of Errors. Besides the editor, N. Bowditch, Alexander M. Fisher, and Melatiah Nash were among the contributors to the *Analyst*.

In 1818, William Marrat became editor of the *Scientific Journal*, which was published at Perth Amboy, N. J., in monthly numbers. Nine numbers are all that are known to have appeared. The cause of the discontinuance seems to have been the departure of Mr. Marrat for England.

In 1825 Robert Adrain started in New York a second periodical, the *Mathematical Diary*, which was published quarterly during the first two years and annually during the last two. The last number contains an excellent likeness of Lagrange, and a sketch of his life. After the first year the editorship of the journal passed into the hands of James Ryan, the author of several mathematical works. In the preface to the first number of the *Mathematical Diary*, Robert Adrain said: "The principal object of the present little work is to excite the genius and industry of those who have a taste for mathematical studies by affording them an opportunity of laying their speculations before the public in an advantageous manner. \* \* \* It is well known to mathematicians that nothing contributes more to the development of mathematical genius than the efforts made by the student to discover the solutions of new and interesting questions." These words may have been prompted by his own experience. We have already pointed out how the *Analyst*, which was edited by him seventeen years previously, was the medium of publishing the first proofs of the all important Law of the Facility of Error in Observations.

Nearly all the more prominent mathematicians of America were contributors to the *Diary*. Among them were Robert Adrain, N. Bowditch, Theodore Strong, Eugene Nulty, Benjamin Peirce, Benjamin Hallowell, William Lenhart, M. O'Shannessy, Henry J. Anderson, and others.

In 1832 the publication was suspended on account of an unfortunate



quarrel among the mathematicians. Mr. Samuel Ward, a then recent graduate of Columbia College, had in part the management of the last number, in which he inserted a dialogue, written by himself, exhibiting in a ridiculous light Henry J. Anderson, then professor of mathematics at Columbia College. High words passed between the parties and their friends, which resulted in the complete breaking up of the Mathematical Diary. Samuel Ward was afterward editor of Young's *Algebra*. In later years he followed wholly different pursuits. He became known in Washington as the "king of the lobby," and as the giver of the best dinners of any man in America.

According to Dr. Hart, a journal called the *Mathematical Companion*, was started by John D. Williams in 1828, and continued for four years. The periodical, says Dr. Hart, was evidently gotten up as a rival of the *Mathematical Diary*. The writer has never seen a copy of this periodical. There is one in the Harvard library.\* Mr. Williams had many opponents, and a bitter contest was carried on between the two parties. He finally issued his fourteen famous "challenge problems," directed against all the mathematicians in America, excepting only Dr. Bowditch, Professor Strong, and Eugene Nulty. Six of these are impossible. All the others have been solved by several persons.<sup>†</sup>

The periodicals which we have named were devoted entirely to mathematics. In addition to these there were publications which were given

\* Dr. Artemus Martin sends us the full title of the journal, as found in Bolton's *Catalogue of Scientific and Technical Periodicals, 1625 to 1872*, published by the Smithsonian Institution, p. 22:—"The Mathematical Companion, containing new researches and improvements in the mathematics, with collections of questions proposed and solved by numerous correspondents. Edited by William D. Williams. 1<sup>st</sup> mo., New York, 1828."†

† In the *Editorial Notes and Queries*, edited by W. D. Hooker, Vol. II, No. 11, January, 1872, will be found a copy of a communication to a new subject made by John D. Williams, in which he contains the fourteen challenge problems," and beginning as follows:

"*My dear Sir*—It is this day's month since, under the signature of *Diophauntus*, I proposed, through the medium of your paper, to the mathematicians of America, a collection of problems and problems in algebra. No correct solution having as yet been presented to the whole, I take this opportunity to fulfill my pledge to publish the solutions of the problems sent to my hands. I now desire to re-propose them, and to give a list of the persons who have accepted from my challenge the Hon. Nathaniel Bowditch, of Boston, Mass.; Mr. Eugene Nulty, of Philadelphia; Prof. Isaac Newton Hurlbut, of New Brunswick, N. J.; only two of the solutions of the problems have been received. Prof. Robert Adams, University of California; Henry J. Anderson, Columbia College, N. Y.; Benjamin Burrows, of New York; George M. Johnson, of Boston, Mass.; Mr. J. Johnson, of Boston, Mass.; Mr. Johnson, of Canton, N. Y.; Mr. Floyd, of New York; C. G. Johnson, of New York; J. L. Johnson, of Cincinnati, Ohio; Benjamin Hurlbut, of New Brunswick, N. J.; and Mr. Johnson, of New York. It being presumed that there are not more than a few persons who have accepted of the above list, would it not be better to give a list of the names of the persons who have accepted of the above list? All problems being in Diophantine analysis, it is not to be known that the subject was then a comparatively favorite one."

to science, or to useful information in general, but which gave part of their space to a "mathematical department." Foremost among these was the Ladies and Gentlemen's Diary, or United States Almanac, etc., edited by Melatiah Nash, for the years 1820, '21, '22. It contained much valuable information in astronomy and philosophy, enigmas, charades, queries, and mathematical problems, to be answered in the succeeding numbers. Other almanacs which generally contained mathematical problems were Thomas's Almanac, published at Worcester, Mass., which existed for more than one hundred years; the Maine Farmer's Almanac; two publications, each called the "Farmers' Almanac;" the Knickerbocker Almanac; the Anti-Masonic Almanac, commenced in 1828 at Rochester, N. Y. Other journals having a mathematical department were the American Monthly Magazine, commenced in New York in the year 1817; the Portico, which was started in Baltimore in 1816 and continued two or three years.

The mathematical journals spoken of were all of the most elementary kind, and, excepting No. IV of the Analyst, which contained Adrain's investigations on least squares, added nothing to the stock of mathematical science. These journals had an educational rather than scientific value. The proposal and solution of problems was the main work done by their contributors. Now, it will certainly be admitted that solving problems is one of the lowest forms of mathematical work. The existence of mathematical journals shows that since the beginning of this century there always were some persons interested in mathematics, but the number was so small that mathematical journals never were a financial success. All the early mathematical periodicals had merely an ephemeral existence.

### III.

#### THE INFLUX OF FRENCH MATHEMATICS.

During the latter part of the eighteenth century we see the French people rising with fearful unanimity, destroying their old institutions, and upon their ruins planting a new order of things. With this period begins the interest in popular education in France. A new impetus was given also to higher scientific education, which continued to be far in advance of that of the rest of Europe.

In 1794 was opened in Paris the Polytechnic School and in the following year the Schools of Application. The Polytechnic School gained a world-wide celebrity. The professors at this institution were men whose names are household words wherever science has a votary. Lagrange, Lacroix, and Poisson laid the basis to its course in analytical mathematics; Laplace, Ampère, and others to that of analytical mechanics and astronomy. Descriptive geometry and its applications had for their first teachers the founder of this science, the illustrious Monge and his celebrated pupils, Hachette and Arago.

The success of the Polytechnic School was phenomenal. It was the nurse of giants. Among its pupils were Arago, Biot, Bourdon, Cauchy, Charles, Duhamel, Dupin, Gay-Lussac, Le Verrier, Poncelet, Regnault. The Polytechnic School is of special interest to those who live in America, because the U. S. Military Academy at West Point was a germ from it.

Compared with the French mathematicians who flourished at the beginning of this century the contemporary American professors were mere infants. The masterpieces of French scholars were unknown in America. What little mathematical knowledge existed here came to us through English channels. For that reason that epoch was called the period of the influx of English mathematics. As compared with colonial times, considerable attention was paid to mathematical studies during that period. But there was still a great dearth in original thinkers on mathematics among us. The genius of our people was exercised in different fields, and so the little science we had was borrowed from others.

But the time came when French writers were at last beginning to make their influence felt among us. We recognized their superiority over the English and profited by it. Mathematical studies received a new impetus. But even then ours was not the glory of the sun, but

only of the moon. The new period produced among us only one mathematician displaying real genius for original research.

It is naturally humiliating to an American when a foreign mathematician like Todhunter, well known for the fairness and candor of his views, pronounces a judgment on Americans like the following: "I have no wish to depreciate their labors; I know that they possess able mathematicians, and that in the department of astronomy they have produced meritorious works; but I maintain that as against us their utmost distinction almost vanishes. And yet, with their great population, their abundant wealth, their attention to education, their freedom from civil and religious disabilities, and their success in literature, we might well expect the most conspicuous eminence in mathematics."<sup>\*</sup>

No thinking American will pronounce this estimate of American mathematicians as entirely unsound; it is, in fact, quite correct. The reasons for this want of productiveness certainly do not lie in any lack of power in the American mind. They will be found rather (1) in the want of interest in and appreciation of abstract scientific work on the part of the American people, and (2) in the bad methods of mathematical instruction in our elementary and higher institutions of learning. There has been no incentive in this country for any large body of men to direct their life-work, day by day, in the line of mathematical investigation. In former years our professors in colleges were, with few exceptions, over-worked in the recitation room; their routine work absorbed all their energies, thereby rendering their minds unfit for original research. Again, every teacher had a stomach; his wife and children had stomachs; the human being must be fed; a livelihood must be earned; the professor's salary was low; not unfrequently he had to add to his duties as instructor in college those of a preacher or private teacher, in order to make his living. Such conditions were not favorable for the growth of science.

But, in spite of all difficulties, there was much progress. The improvements in mathematical text-books and reforms in mathematical instruction were due to French influences. French authors displaced the English in many of our best institutions. It is somewhat of a misfortune, however, that we failed to gather in the full fruits of the French intellect. We followed in the path of French writers whose works had ceased to be the embodiment of the later results of French science; many of the works which we adopted were beginning to be "behind the times," when introduced in America. We used works of Bezout, Lacroix, and Bourdon. But Bezout flourished before the French Revolution, and Lacroix wrote most, if not all, of his books before the beginning of this century. In 1821 Cauchy published in Paris his *Cours d'Analyse*. If thoughtful attention and study had been given by our American text-book writers to this volume, then many a lax, loose, and unscientific method of treating mathematical subjects might have been

<sup>\*</sup>The Conflict of Studies and Other Essays, by L. Todhunter. London, 1873, p. 100.

corrected at the outset. The wretched treatment of infinite series, as found in all our text-books, excepting the most recent, might have been rejected from the very beginning.

In thinking of the influx of French mathematics, we must guard against the impression that French authors and methods entirely displaced the English. English books continued to be used in some of our schools. Many an old English notion has remained with us to the present day. We still have the English weights and measures. The old line-system in trigonometry, which we got from the English, but which they long since rejected, has until very recently been finding favor among many of our teachers.

There have been improvements in the methods of instruction, but not so extensive as might be wished. Traditional methods have long had almost full sway. The mathematical teaching has been bad. One of the most baneful delusions by which the minds, not only of students, but even of many teachers of mathematics in our classical colleges, have been afflicted is, that mathematics can be mastered by the favored few, but lies beyond the grasp and power of the ordinary mind. This chimera has worked an untold amount of mischief in mathematical education. The students entered upon their studies with the feeling that there was no use trying to learn mathematics, and the teacher felt that there was no use trying to teach it. This humiliating opinion of the powers of the average human mind is one of the most unfortunate delusions which have ever misled the minds of American students and educators. It has prevailed among us from the earliest times. In the latter part of the last century, the notion was general among us that girls could not be taught fractions in arithmetic, and that lady teachers were unfit, for want of mental capacity, to give instruction in arithmetic. Warren Burton says that a school-mistress "would as soon have expected to teach the Arabic language as the numerical science." But this delusion has now vanished. The best instruction in elementary arithmetic is now given by lady teachers. Among the contributors to the *American Journal of Mathematics* there are two ladies. In the same way the delusion will soon vanish that the average college student is not able to grasp the more advanced branches of exact science. The trouble has been, all along, not so much in the lack of ability in students, as in the wretched character of the mathematical instruction. Such is the opinion of Professor Olney, one of the most efficient drill-masters and teachers of mathematics that this country has produced. In the preface to his *General Geometry and Calculus* he says: "Nor is it impracticable for the majority of students to become intelligent in these subjects. They do not lie beyond the reach of good common minds, nor require peculiar mental characteristics for their mastery. The difficulty hitherto has been in the methods of presentation, in the limited and totally inadequate amount of time assigned them, and more than all in the preconceived notion of their abstruseness."

One of the causes of the bad instruction in our colleges has been the system of tutorships. Fortunately, this relic of scholasticism is now rapidly disappearing. Young students who needed a skilled teacher of long experience to guide them and to awaken in them a spirit of free inquiry were intrusted to inexperienced youths who had just graduated from college, and who had themselves never felt the glow of the spirit of independent inquiry. Students did not find their mathematics interesting, nor did they understand it well. Their hatred of mathematics had its cause in these two facts, which stand in the closest possible connection with each other. "We might say, either that the study failed of being understood, because it was uninteresting, or that it awakened no interest, because it was not well understood. Both these statements were true."\* Professor Eddy truly says that very few students "do really become in any true sense masters of the mathematical subjects which they study, or indeed have sufficient practice in the principles which they attempt to learn, to be capable of judging whether they have been so mastered as to accomplish the ends which should be sought in mathematical training." The great desideratum in our preparatory schools and colleges has been less memorizing, less cramming, more thorough training in the fundamental branches, more object teaching, more drill, more frequent and well-guided original inquiries, greater freedom from formalism, a stronger spirit of free inquiry.

Says Professor Eddy: "When, as often happens, our college graduates go abroad for post-graduate study in departments requiring previous mathematical training, what do they find their requirements in this direction to amount to? I think I may say that a large proportion of them find themselves almost hopelessly lacking in the essentials of such training, and not at all fitted to make proper improvement of the advantages of which they have sought to avail themselves. Our young men are unequal to the mathematical studies which those of the same age, but of European academic training, successfully carry. Now, where does the difficulty lie? Not in any inferior talent for these studies, as I have the best of reasons for believing, but from a lack of opportunity for obtaining a comprehension of the infinitesimal calculus, in which they usually find themselves almost wholly wanting." Nor are they always able to manipulate, with any degree of ease, the more complicated expressions of ordinary algebra. They have been taught by a "daily lecture instead of a daily drill," a method of teaching which is like "explaining tactics instead of practicing them." Or, whenever text-books were used, "the recitations were mere hearings of lessons, without comment or collateral instruction."†

Professor Eddy's reminiscences of his own study of mathematics in college are not pleasant. Nor is his experience exceptional. On the con-

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\* "College Mathematics," by Henry T. Eddy, in the *Proceedings of the American Association for the Advancement of Science*, Vol. XXXIII, 1884.

† *Harvard Reminiscences*, by A. P. Peabody, p. 201.

trary it has been the rule rather than the exception in our classical colleges. In reply to a request made by the writer to give his recollections of the mathematical teaching at one of our oldest classical colleges, a now prominent professor of mathematics replied that he did not think he had "any such recollections" as he "should care to put in print." Another one gives his reminiscences, but marks his letter "personal and private."

If our classical colleges had caught something of the spirit that must have prevailed at the Polytechnic School in Paris in the days of Lagrange, Laplace, Lacroix, Ampère, when it produced such thinkers as Arago, Cauchy, Le Verrier, then the list of our prominent mathematicians and astronomers would doubtless have been doubled or tripled. We got from the French some of their old text-books, but we failed to catch their love of scientific study and inquiry.

On a previous page it has been stated that Americans had come to recognize the superiority of French mathematicians over the English. It should have been added that we did not see this superiority until it was pointed out to us by the English themselves. The influx of French mathematics into the United States was preceded by an influx of French mathematics into England. In Britain there were men who had come to deplore the very small progress that science was making there, as compared with its racing progress on the continent. In 1813 the "Analytical Society" was formed at Cambridge. This was a small club established by Peacock, John Herschel, Babbage, and a few other students at Cambridge, to promote, as it was humorously expressed, the principles of pure "D-ism," that is, of the Leibnitzian notation in the calculus, against those of "dot-age," or of the Newtonian notation. This struggle ended in the introduction into Cambridge of the Continental notation  $\frac{dy}{dx}$  to the exclusion of the fluxional notation ( $\dot{y}$ ). This was a great step in advance, not on account of any great superiority of the Leibnitzian over the Newtonian notation, but because the adoption of the former opened up to English students the vast storehouses of Continental discoveries.

The movement against the fluxional notation began in this country about ten years later than it did in England, and proceeded more quietly. John Farrar, of Harvard, translated from the French the Differential and Integral Calculus of Lacroix, which employed the Continental notation, in 1824. Professor Fisher, of Yale, who died in 1822, published mathematical lectures in Stillman's Journal, employing the new notation. At any earlier date than this there were men connected with West Point who had been trained in the Continental system. Thus, F. R. Hassler, educated at the University of Bern, was teacher of mathematics at West Point from 1808 to 1810. Probably neither calculus nor fluxions were taught there during that time, for, as late as 1816, we read in the West Point curriculum that *fluxions* were "to be taught at the

option of professor and student." In 1817, Orozet, trained at the Polytechnic School in Paris, became teacher of engineering at the Military Academy. In this country he, sometimes at least, used the Newtonian notation. He did so, for instance, in the solution, in French, of a problem which he published in the *Portico*, of Baltimore, in 1817. The Leibnitzian notation must have been introduced at the Military Academy very soon after the year 1817.

Robert Adrain used the English notation in his earlier writings. In the *Portico*, Vol. III, he does so, but in *Nash's Ladies and Gentlemen's Diary*, No. II, published in New York in 1820, he employs the notation  $dx$ . We are told that while he was at Columbia College, between 1813 and 1826, he wrote a manuscript treatise on the Differential and Integral Calculus. We know also that he was a diligent student of the works of Lagrange and Laplace, which contained the notation of Leibnitz throughout. The first article in the *Memoirs of the American Academy of Arts and Sciences*, which contains the "d-istic" notation, was published in 1818 by F. T. Schubert. It is well known that Bowditch began the translation of the *Mécanique Céleste* of Laplace as early as 1814. At that time he was, therefore, thoroughly conversant with pure "D-ism." He had been converted to the new "ism" on the long sea voyages, from 1795 to 1804, when he studied Lacroix's *Calculus*. In general, it may be stated that the change of notation took place in the United States about the close of the first quarter of this century.

The publication of Bowditch's Laplace, begun in 1829, gave a powerful stimulus to the study of French mathematics and to the general advancement of mathematical learning in America. Says Edward Everett: "This may be considered as opening a new era in the history of American science."

This may be a convenient place to consider that work at some length. As it originally appeared in France, the *Mécanique Céleste* was described by the *Edinburgh Review*, one of the leading scientific journals in Great Britain, as being of so abstruse and profound a character that there were scarcely a dozen men in all that country capable of reading it with any tolerable facility. These remarks created great curiosity in Bowditch to explore the work. He began translating it in 1814, and pursued it with such ardor and persistence that he accomplished it in only two years.

In order to state briefly the object of the work of La Place, we quote from his preface to it as follows:

"Toward the end of the seventeenth century, Newton published his discovery of universal gravitation. Mathematicians have since that epoch succeeded in reducing to this great law of nature all the known phenomena of the system of the world, and have thus given to the theories of the heavenly bodies and to astronomical tables an unexpected degree of precision. My object is to present a connected view of these theories which are now scattered in a great number of works. The whole of the results of gravitation upon the equilibrium and motions



of the fluid and solid bodies which compose the solar system and the similar systems existing in the immensity of space, constitute the object of *Celestial Mechanics*, or the application of the principles of mechanics to the motions and figures of the heavenly bodies. Astronomy, considered in the most general manner, is a great problem of mechanics, in which the elements of the motions are the arbitrary constant quantities. The solution of this problem depends, at the same time, upon the accuracy of the observations and upon the perfection of the analysis. It is very important to reject every empirical process, and to complete the analysis, so that it shall not be necessary to derive from observations any but indispensable data. The intention of this work is to obtain, as much as may be in my power, this interesting result.\*

Though the translation was completed as early as 1817, the publication did not begin until 1829. In 1817 the income of Bowditch was so small that he could not afford to have the translation published. The American Academy of Arts and Sciences offered to publish the work at their own expense. He was also solicited to publish it by subscription. But his independence of spirit induced him to decline these proposals. He was aware that the work would find but few readers, and he did not wish any one to feel compelled or to be induced to subscribe for it, lest he should have it in his power to say, "I patronized Mr. Bowditch by buying his book, which I can not read." Later on he was able to commence the publication at his own expense.

The objects which Bowditch endeavored to accomplish by his translation and commentary, as stated by his biographers, were as follows:

(1) To supply those steps in the demonstration which could not be discovered without much study, and which had rendered the original work so difficult. The difficulty arose not merely from the intrinsic complexity of the subject and the medium of proof by the higher branches of mathematics, but chiefly from the circumstance that the author, taking it for granted that the subject would be as plain and easy to others as to himself, very often omits the intermediate steps and connecting links in his demonstrations. He jumps over the interval and grasps the conclusion by intuition. Bowditch used to say, "I never come across one of Laplace's '*Thus it plainly appears*' without feeling sure that I have hours of hard work before me to fill up the chasm and find out and show *how* it plainly appears."<sup>6</sup>

(2) The second great object of the translation was to continue the original work to the present time, so as to include the many improvements and discoveries in mathematical science that had been made during the twenty-five years succeeding the first publication. It is gratifying to know that the most eminent of contemporary mathemati-

\* "The *Mécanique Céleste* is by no means easy reading. But, who assisted Laplace in revising it for the press, says that Laplace himself was frequently unable to recover the details in the chain of reasoning, and if satisfied that the conclusions were right he was content to insert the constantly recurring formula, '*Il est aisé à voir.*'" W. W. R. DALL'S *Short History of Mathematics*, p. 327.

cians pronounced his commentary a success, and agreed that Bowditch had attained the end he had in view, namely, to bring the work up with the times. Says Lacroix, July 5, 1836: "I am more and more astonished at a task so laborious and extensive. I perceive that you do not confine yourself to the mere text of your author and to the elucidations which it requires, but you subjoin the parallel passages and subsequent remarks of those geometers who have treated of the same subjects; so that your work will embrace the actual state of the science at the time of its publication." Legendre, July 2, 1832, says: "Your work is not merely a translation with a commentary; I regard it as a new edition, augmented and improved, and such a one as might have come from the hands of the author himself, if he had consulted his true interest, that is, if he had been solicitously studious of being clear." Mr. Babbage, of England, August 5, 1832, says: "It is a proud circumstance for America, that she has preceded her parent country in such an undertaking; and we in England must be content that our language is made the vehicle of the sublimest portion of human knowledge, and be grateful to you for rendering it more accessible." Similar testimony was given by Bessel and Encke in Germany; Puissant in France; Sir John Herschel, Airy, Francis Baily in England, and Cacciatori in Italy.

Bowditch once remarked that however flattering the testimony from foreigners might be, yet the most grateful tribute of commendation he had ever received was contained in a letter from a backwoodsman of the West, who wrote to him to point out an error in his translation of the *Mécanique Céleste*. "It is an actual error," said he, "which had escaped my own observation. The simple fact that my work had reached the hands of one on the outer verge of civilization who could understand and estimate it was more gratifying to my feelings than the eulogies of men of science and the commendatory votes of Academies." In America, many college professors were enabled by means of the translation and commentary to read and understand the *Mécanique Céleste*, who would otherwise have looked upon this work as a sealed book.

During the first thirty-five or forty years of this century but little was accomplished in this country in the line of astronomical observations. More was done in that respect during the days of David Rittenhouse than in the early part of this century. But, all at once, a great impetus was given to this kind of scientific work. In 1830 was erected the Yale College Observatory; in 1831 the observatory at the University of North Carolina; in 1836 the Williams College Observatory; in 1838 the Hudson Observatory, Ohio; in 1840 the Philadelphia High School Observatory and the West Point Observatory; in 1842 the National Observatory at Washington. Since then a large number of other observatories with excellent instruments have been built.

A plan for a National Observatory was submitted to the Government by Mr. Hassler, in his project for the survey of the Atlantic coast, as early as 1807. The proposition met with no favor. For many years

Congress opposed every such scheme. John Quincy Adams, in his annual message of 1825, strongly urged this subject upon the attention of Congress. In one place he said, "It is with no feeling of pride, as an American, that the remark may be made that, on the comparatively small territorial surface of Europe there are existing upward of one hundred and thirty of these light houses of the skies; while throughout the whole American hemisphere there is not one." President Adams's appeal was received with a general torrent of ridicule. "The proposition," says Loomis,\* "to establish a light-house in the skies became a common by-word of reproach." It was not till 1843 that an appropriation was passed for an observatory, under the disguised name of a "Depot of Charts and Instruments."

It need hardly be said that in later years the U. S. Government has been very liberal in the encouragement of science.

#### ELEMENTARY SCHOOLS.

The beginning of this period is marked by a great revival of elementary education. Pestalozzian ideas had gained a foothold in England, and were now commencing to force their way into the western continent. In 1806 F. J. N. Neef, once an assistant to Pestalozzi, came to this country, and began teaching and disseminating the ideas of the Swiss reformer. The first fruit of Pestalozzian ideas in the teaching of arithmetic among us was Warren Colburn's *Intellectual Arithmetic* upon the Inductive Method of Instruction, known as the "*First Lessons*."

Warren Colburn worked, while a boy, at the machinist's trade. He then entered Harvard and graduated in 1820, having "mastered calculus and read a large part of Laplace." He then taught a select school in Boston. At this time he began preparing his little book. Of special interest is the following statement of Mr. Batchelder, of Cambridge, which shows how the *First Lessons* were prepared: "I remember once, in conversing with him with respect to his arithmetic, he remarked that the pupils who were under his tuition made his arithmetic for him; that he had only to give attention to the questions they asked and the proper answers and explanations to be given, in order to anticipate the doubts and difficulties that would arise in the minds of the pupils." He had read Pestalozzi, most probably, while in college. A manuscript copy of his *First Lessons* was furnished by Colburn to his friend George B. Emerson for use in a school for girls, and the former received valuable suggestions from the latter. The success of the book was almost immediate. No school-book had ever had such sale among us as this. Over three and one-half million copies were used in this country, and it was translated into several European languages.

Colburn's *First Lessons* embodied what was then a new idea among us. Instead of introducing the young pupil to the science of numbers, as did

\* *Recent Progress in Astronomy, especially in the United States, by Elias Loomis. New York, 1-50, p. 235.*

old Dilworth, by the question, "What is arithmetic?" and the answer, "Arithmetic is the art or science of computing by numbers, either whole or in fractions," he was initiated into this science by the following simple question: "How many thumbs have you on your right hand? How many on your left? How many on both together?" The idea was to begin with the concrete and known, instead of the abstract and unknown, and then to proceed gradually and by successive steps to subjects more difficult. In the publication of this book, the study of arithmetic in the schools of this country received its best impulse. "It led to the adoption of methods of teaching that have lifted the mind from the slavery of dull routine to the freedom of independent thought." (Edward Brooks.)

Colburn's *First Lessons* was followed in 1826 by his *Arithmetic upon the Inductive Method of Instruction*, being a Sequel to *Intellectual Arithmetic*. This was considered by its author to be superior to the *First Lessons*, but it did not meet with so great success. In 1825 he published his *Algebra upon the Inductive Method of Instruction*. Mr. Colburn did not long engage in teaching. Three years after graduation from college he was appointed superintendent of a manufacturing company at Waltham, and, soon after, of one at Lowell, Mass. He possessed great mechanical genius and administrative ability.

Though the *First Lessons* met with ready appreciation in New England, it must not be imagined that there was no opposition to it. Old notions could not be laid aside at once, and even where the new ideas had gained entrance, new books could not always be had readily. Now-a-days we are apt to forget the difficulty and expense of transportation during the times preceding our railroad era. Says J. Stockton, in the preface to his *Western Calculator* (fourth edition, 1823, Pittsburg, Pa.), "to furnish our numerous schools, in the western (!) country, with a plain and practical treatise of arithmetic, compiled and printed among ourselves, thereby saving a heavy annual expense in the purchase of such books, east of the mountains, and likewise the *carriage thereof*, have been the motives which induced the compiler to undertake this work."

In spite of all obstacles Colburn's books gained ground steadily. Other books were written upon the same idea by different teachers. Old books underwent revision, so as to embody the new methods in part. Thus, the celebrated *School-masters' Arithmetic* of Daniel Adams, first published in 1801, was made to undergo a radical change. The old work was "synthetic." "If that be a fault of the work," says the author, "it is a fault of the times in which it appeared. The analytic or inductive method of Pestalozzi . . . is among the improvements of later years. It has been applied to arithmetic with great ingenuity by Mr. Colburn in our own country." "Instructors of academies and common schools have been so long attached to the old synthetic method of instruction, that, unhappily, many are still (1829) strongly opposed to the introduction of the valuable works of Colburn." "This [Adams's] work combines the new and the old."

The great success of Colburn's book did not prevent the appearance of arithmetical works that were quite as worthless as any of earlier years. There appeared others, on the other hand, which possessed no little merit and became very popular. As examples of the latter we would mention the arithmetics of the two brothers, Benjamin D. and Frederick Emerson, both of whom were well-known teachers in Boston.

The arithmetics of later days are combinations of the old, as found in our early arithmetics, and the new as found in the works of Colburn. For example: Our old arithmetics generally rejected reasoning, but gave rules; Colburn's books reject rules, but encourage reasoning. The better class of our later arithmetics contain rules, but, at the same time, give demonstrations and encourage students to think.

About the year 1825 or 1830, the French notation of numbers began rapidly to displace the English. Large numbers came to be marked off in periods of three digits instead of six. The earliest book in which we have noticed the adoption of the French notation is Robert Patterson's edition of Dilworth's *School-master's Assistant*, Philadelphia, 1805; the latest in which we have seen the English notation used is M. Gibson's revised edition of Abijah and Josiah Fowler's *Youth's Assistant*, Jonesborough, Tenn., 1850. Some of our recent books explain both, but use the French.

It is a rather curious fact that the process of *cancellation* did not come to be generally used in our arithmetics before about 1850. In 1840 C. Tracy published an arithmetic in which cancelling was freely used, a feature which was then "entirely peculiar to this treatise," and which distinguished it "from all others." John L. Talbott's *Practical Arithmetic* (Cincinnati, 1853) gives the "cancelling system," but only in the appendix, and remarks in the preface to it, "In Europe this system has been very generally adopted in the higher schools, and in this country it is fast becoming known—and, so far as it is known, it supercedes the usual modes of operation." Charles Davies takes pains to remark on the title page of his *University Arithmetic* (1857) that "the most improved methods of analysis and *cancellation*" have been employed.

The order in which the various arithmetical subjects have come to be taught has been generally improved upon. Federal money and compound interest no longer precede common and decimal fractions, but come after them. Fractions have been moved much further toward the front part of our books. The placing of fractions toward the end of arithmetics had been due to the fact that the majority of pupils in olden times did not pursue mathematics long enough to master fractions, and were thus put through a course in arithmetic with only integral numbers. Those who *did* study fractions were made to learn the rules of interest and proportion over again "in vulgar fractions," and then again "in decimal fractions." Some of the old topics, such as single and double position, have since been quite generally dropped, but we think that there is still room for improvement in that respect. Nothing would

be lost and much gained if alligation, square and cube root, mensuration, and some of the more difficult applications of percentage should be dropped from our arithmetics. At least one new subject has been quite generally and, we think, appropriately introduced into our books—the metric system.

Before the time of Colburn, mental arithmetic was quite unknown in our schools. Since then mental and written arithmetic have not always been so closely united as they should be. The methods used in the two were frequently quite diverse. Too often they were taught almost like distinct sciences, so that a pupil might be quite proficient in the one without knowing anything of the other.

Grube's method of teaching numbers to children has been in use among us, especially in the East, but has never been generally adopted. It is such a refined method that few teachers possess the skill to apply it readily. The method has a desirable tendency to train ready and rapid calculators, and has much to commend itself to teachers.\*

Since the beginning of this century arithmetic has come to be regarded as the most important, because the most practical, science in our elementary schools. Every farmer wished his sons to be good calculators; every business man desired to be "quick at figures;" hence its value was high in the estimation of all. Bookmakers were quick to profit by this sentiment. They began to multiply the number of textbooks in the course until there were two books in mental arithmetic, and three in written, in several of the series in general use. As a rule, the examples in our arithmetics have not been well graded; difficult examples have been introduced so early in the course as to embarrass and discourage even the best students. Many examples were regular puzzles, not only to young boys and girls, but to almost any one not trained in algebra. There are numerous problems that should never have found a place in our arithmetics. We could quote from arithmetics dozens and dozens of such problems, but we shall give only one.

The 137th problem of the miscellaneous questions in the third part of Emerson's *North American Arithmetic*, published in 1835, is as follows:

If 12 oxen eat up  $3\frac{1}{2}$  acres of grass in 4 weeks, and 21 oxen eat up 10 acres in 9 weeks, how many oxen will eat up 24 acres in 15 weeks; the grass being at first equal on every acre, and growing uniformly.

The idea of placing a problem of such difficulty in a book for boys and girls! The history of this problem in this country shows very plainly that it is beyond the power, not only of pupils, but even of teachers of arithmetic. Many teachers whose minds had been trained by the study of algebra and geometry and, perhaps, even higher branches of mathematics, wrestled with it in vain. There existed so much uncertainty regarding its true solution that a premium of fifty

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\* For further information on Grube's method, see Prof. T. H. Safford's monograph on *Mathematical Teaching*, pp. 19.

dollars was offered in June, 1835, for the most "lucid analytical solution" of this question. A committee was appointed, with P. Mackintosh as chairman, to examine the solutions presented and award the prize. The committee reported 112 solutions received, of which only 48 gave the true answer, and awarded the prize to Mr. James Robinson, principal of the department of arithmetic, Bowdoin School, Boston.\*

Think of it! Out of 112 of, presumably, the best arithmeticians in the country, only 48 got correct results; and yet this problem was intended to be solved by boys and girls.

But the history of our problem is not yet complete. Nearly twenty-five years later a revision of Mr. Robinson's solution was submitted to the National Teachers' Association, at Washington, by the Hon. Finley Bigger, then Register of the U. S. Treasury; it was referred to the *Mathematical Monthly* for publication, and was printed in Vol. II, No. 3, December, 1859, pp. 82-85. Mr. Bigger assumed, "for the purpose of elucidation," that the question was susceptible of two constructions, and obtained two answers in addition to the true one. The editor of the *Monthly* appended an algebraic solution, and showed that there was only one answer that would satisfy all the conditions of the problem, and that Mr. Bigger was wrong in his conclusions.

There is no ambiguity in the problem. Twenty-three years later, Dr. Artemas Martin published several solutions of the problem in the *Mathematical Magazine*. Dr. Martin does not consider Mr. Robinson's solution very "lucid," and pronounces it liable to at least one other objection—it makes "mince meat" of the oxen, inasmuch as fractions of oxen occur throughout the analysis of the question.

There is another curious fact connected with the history of this problem. Neither Mr. Emerson, nor the committee, nor Mr. Robinson, nor Mr. Bigger, nor the National Teachers' Association, nor the *Mathematical Monthly*, alludes to the fact that the question is taken from the *Arithmetica Universalis* of Sir Isaac Newton, published in 1704, which contains a "lucid analytical solution." Mr. Emerson's statement of the problem differs from that of Newton in this, that, owing to a misprint, the fraction  $\frac{1}{2}$  instead of  $\frac{1}{4}$  is given by the former in the number of acres contained in the first pasture, which mistake produces the absurd result of  $67\frac{1}{2}$  oxen, instead of 36. The above question goes by the name of the "pasturage problem."

There exists a general feeling among mathematicians and educators that the teaching of arithmetic has been overdone in our schools. Parents have desired their older boys to be good mathematicians. But they failed to perceive the truth that the best review of arithmetic consists in the study of algebra; they looked upon algebra as utterly destitute of value. In consequence the boys have been made to waste

\*H. Emerson, *ed.* Vol. III, p. 71. Also the *Mathematical Magazine*, edited by Dr. Artemas Martin, Vol. I, pp. 17 and 43.

their time at the study of circulating decimals, difficult problems in stocks and exchange, in general average, in alligation medial and alligation alternate, in square and cube root, and in combinations and permutations. From the manner in which these subjects have been treated in our arithmetics, a student derives very little mental training from them. The presentation of duodecimals is not only unphilosophical, but decidedly absurd.

Protests have been made from time to time against the over-study of arithmetic. Thus in 1866 the Superintendent of Public Instruction of California said in his Report (p. 119): "The crack classes are the arithmetic classes, and the merits of a whole school not unfrequently rise or fall with the exploits of the first class in arithmetic on 'examination day.' Arithmetic is well enough in its place, but the sky is not a blackboard, nor are mountains all made of chalk. Children have faculties other than that of calculation, and they need to be exercised on appropriate subjects." This doubtless voices the sentiments of many thinking teachers. Five years ago the writer heard Prof. Simon Newcomb, in a lecture at the Johns Hopkins University, protest against existing practices in the teaching of arithmetic.

Says Prof. T. H. Safford, of Williams College: "The mathematics have their (disciplinary) value, and a very high one it is; but the lower mathematics, especially arithmetic, have been overdone in a certain direction; I mean that of riddles, puzzles, brain-spinning, as the Germans call it. While our boys and girls are given problems to solve which quite exceed their thinking powers—I don't suppose I could ever have gone successfully through Greenleaf's National Arithmetic till I had graduated from college—their minds are quite undeveloped in the power of observation, and they are often imperfectly trained in the four ground rules, especially in decimal fractions."<sup>\*</sup>

A very remarkable and encouraging step toward reform was taken in 1887 by the Boston School Board. It passed the following orders concerning the study of arithmetic:<sup>†</sup>

"1. Home lessons in arithmetic should be given out only in exceptional cases.

"2. The mensuration of the trapezoid and of the trapezium, of the prism, pyramid, cone, and sphere; compound interest, cube root and its applications; equation of payments, exchange, similar surfaces, metric system, compound proportion, and compound partnership, should not be included in the required course.

"3. All exercises in fractions, commission, discount, and proportion, should be confined to small numbers, and to simple subjects and processes, the main purpose throughout being to secure thoroughness, accuracy, and a reasonable degree of facility in plain ordinary ciphering.

<sup>\*</sup> *The Development of Astronomy in the United States*, 1883, p. 27.

<sup>†</sup> *The Academy*, January, 1888, article: "Arithmetic in Boston Schools," by General Francis A. Walker, President of the Massachusetts Institute of Technology.



"4. In 'practical problems,' and in examples illustrative of arithmetical principles, all exercises are to be avoided in which a fairly intelligent and attentive child of the age concerned would find any considerable difficulty in making the statement which is preliminary to performance of the properly arithmetical operations. When arithmetical work is put into the form of practical or illustrative problems must be for the purpose of interesting and aiding the child in the performance of the arithmetical operations, and with a view to their common utility.

"5. In oral arithmetic no racing should be permitted; but the dictation should be of moderate rapidity.

"6. The average time devoted to arithmetic throughout the primary and grammar school course should be three and a half hours a week and in the third primary grade not more than two hours, and in first and second primary grades not more than three and a half hours each per week."

The considerations which led the School Board to introduce these changes are admirably set forth by General Francis A. Walker. The regulation regarding home lessons in arithmetic may be a good one under the conditions existing in Boston at the time of its adoption, but it hardly be recommended for general adoption. It sounds somewhat arbitrary. The reasons which led to its adoption are, (1) a tendency among grammar school teachers to unduly magnify the importance of arithmetic; (2) the injustice done as between pupil and pupil by giving home lessons, since the facilities for study at home are so very different among pupils; (3) the absence of the teacher prevents any authoritative interposition to put a stop to excessive, and therefore damaging study over problems in the lesson. "In the old flogging days of Army and Navy," says General Walker, "it was always required that the surgeon should stand by, to feel the pulse of the poor wretch under the lash, to watch the signs of approaching nervous collapse, and, in his discretion, to forbid the punishment to proceed further. But in case of our young children who are assigned home lessons in arithmetic no such humane provision exists. Were the work being done in an open school room, the severest master would, when he saw that a child did not understand the problem, could not do the work, and that it was only becoming more excited and fatigued by repeated attempts, interpose either to give assistance or to put a stop to the exercise. In case of home lessons, however, the ambitious and sensitive child finds no relief. The work may go on long after the child should have been in bed until a state is reached where further persistence is not only the highest degree injurious, but has no longer any possible relation to success."

"Regarding the remaining five orders, considered as a body," says General Walker, "it may be said that the committee, in framing the

were actuated by the belief that both loss of time and misdirection of effort, with even some positively injurious consequences, were involved in the teaching of arithmetic, as carried on in some of the Boston schools. And here let me say, to prevent misapprehension, that the committee at no time intended to reflect on the schools of our own city as compared with those of neighboring cities and towns. Personally, I believe that the teaching of arithmetic has been more humane and rational of late years in the schools of Boston than in those of most New England towns and cities. What, then, are the faults complained of?

*“First*—That the amount of time devoted to this study is in excess of what can fairly be allotted to it, in the face of the demands of other and equally important branches of study.

*“Secondly*—That the study of arithmetic is very largely pursued by methods supposed to conduce to general mental training, which, in a great degree, sacrifice that facility and accuracy in numerical computations so essential in the after-life of the pupil, whether as a student in the higher schools or as a bread-winner.

*“Thirdly*—That, as arithmetic is taught in many, perhaps in most schools, the possible advantages of this branch of study, even as a means of general mental training and of the development of the reasoning powers, are, whether by fault of the text-book or of the individual teacher or of the standards adopted for examination, largely sacrificed through making the exercises of undue difficulty and complexity, which not only destroys their disciplinary value but becomes a means of positive injury.”

The whole paper of General Walker is well worth reading. In one respect, however, we can not endorse the action of the Board. It seems to us that the metric system should be retained, even if the tables of apothecaries' weights and fluid measure, and of the mariner's measure, had to be omitted to make room for it. The memorizing of the tables in the metric system is not difficult. Moreover, what problems offer better opportunities for a good, thorough course in the use of decimal fractions than those involving meters and decimeters.

But there is still another reason for urging the spread of a knowledge of the metric system in elementary schools. If the masses have once acquired sufficient knowledge and familiarity with it as to see its transcending superiority over the old traditional tables of weights and measures now in use, then we may look forward more hopefully to the early approach of the time when the French weights and measures will be declared the only legal ones in the United States.

European nations that are generally regarded as being much more conservative than our own, have introduced them, to the exclusion of older ones. Even the miniature republic of Switzerland has, within the last ten years, adopted the metric system. The change was brought about without serious inconvenience.

## UNITED STATES MILITARY ACADEMY.\*

In 1817 began a new epoch in the history of the United States Military Academy. At this time Maj. Sylvanus Thayer became superintendent, and under him the Academy entered upon a career of unusual prosperity. Thayer was a native of Massachusetts, graduated at Dartmouth College, and then entered the Military Academy as a cadet in 1807. He was appointed lieutenant in the corps of engineers in 1808. At the close of the War of 1812 he was sent abroad by the Government to look into the military systems of Europe, particularly of France. After his return the Academy was reorganized according to French ideals, but without discarding entirely English teachings. Prof. Charles Davies says that in the construction of the course of study at West Point, "the beautiful theories of the French were happily combined with the practical methods of the English systems, and the same has since been done, essentially, in the schools of England and France." Maj. E. C. Boynton, in his History of West Point, summarizes the services of Major Thayer in the following manner: "The division of classes into sections, the transfers between the latter, the weekly rendering of class reports, showing the daily progress, the system and scale of daily marks, the establishment of relative class rank among the members, the publication of the Annual Register, the introduction of the Board of Visitors, the check book system, the prepondering influence of the blackboard, and the essential parts of the regulations for the Military Academy as they stand to this day, are some of the evidence of the indelible efforts of Major Thayer to insure method, order, and prosperity to the institution. It was through the agency of Major Thayer that Prof. Claude Crozet, the parent of descriptive geometry in America, and one of the first successful instructors in higher mathematics, permanent fortifications, and topographical curves, became attached to the Academy." Crozet had been a French officer under Napoleon, and a pupil at the Polytechnic School in Paris.

Thayer was superintendent at West Point from 1817 to 1833. The great reputation which the Academy obtained was chiefly due to his efforts. His discipline was very strict. The last years of his administration were years of trial to him. It is said that his discipline was counted too stern, and that he was not sustained, as he should have been, at the War Department. Differences arose between him and the President of the United States, resulting in his leaving the Academy. General Francis H. Smith says of him that "Colonel Thayer held the reins with a firm hand, and he was not to be shaken from his position, and that at times, he transcended the limits of legitimate authority, to private pique or personal interest swayed his judgment. He was animated by the single desire to give

\*The history of the Military Academy at West Point is given in a regular and complete manner in the History of the United States Military Academy, by E. C. Boynton, New York, 1874, pp. 6.

†West Point, 1817, Years A. New York, 1874, p. 6.

efficiency to his discipline, and to train every graduate upon the highest model of the true soldier."

Andrew Ellicott was professor of mathematics from 1813 to 1820. The following description of him applies to the time preceding the arrival of Thayer. Says E. D. Mansfield: "There are some who will recollect Professor Ellicott sitting at his desk at the end of a long room, in the second story of what was called the Mess Hall, teaching geometry and algebra, looking and acting precisely like the old-fashioned school-master, of whom it was written,

" 'And still they gazed, and still the wonder grew  
That one small head could carry all he knew.'"

"In the other end of the room, or in the next room, was his acting assistant, Stephen H. Long. \* \* \* The text-book used was Hutton's Mathematics, and at that time the best to be had. \* \* \* It was a good text-book then, for there were no cadets trained to pursue deeper or more analytical works."

As already stated, Superintendent Thayer caused the classes to be divided into sections. From the reminiscences given by John H. B. Latrobe, who entered the Academy as a cadet in 1818, we see that the various sections received their mathematical instruction from assistants, and that the professor of mathematics occasionally visited the sections. Mr. Latrobe says: "I do not remember upon what principle our class of one hundred and seventeen members was divided into four sections; I recollect, however, that I was put into the first section. \* \* \* Our recitation room was next the guard room, on the first floor of the North Barracks. Here, on a rostrum, between two windows, sat Assistant Professor S. Stanhope Smith, and here, with the first volume of Hutton's Mathematics in hand, I began my West Point education. \* \* \*

"I am not sure that we had desks, but rather think that we were seated on benches against the wall, with a blackboard to supply the place of pen and ink and slates, although I am not certain about the slates. Generally we had the section room to ourselves. Sometimes, however, Mr. Ellicott would pay us a visit and ask a few questions, ending with giving us a sum in algebra, to explain what was meant by 'an infinite series,' which was the name he went by in the corps."

"I have," continues Latrobe (p. 29), "no other recollection of him as an instructor, except once when, while learning surveying, we were chaining a line from a point in front of his house to an angle of Fort Clinton, and back again. Our accuracy quite astonished the good old professor, to whom we did not admit that it was owing to our having used the same holes that the pins had made in going and returning."

Professor Ellicott died at West Point and was buried in the cemetery there. "My last visit to it as a cadet," says Latrobe, "was when I

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\* Report Association of Graduates of the U. S. Military Academy, 1887, p. 8.

was on the escort that fired the volleys over the grave of Andrew Ellicott, the professor of mathematics who lies buried there."

Of Hutton's Mathematics Latrobe says: "I have often heard those who have been more recently educated at West Point speak disparagingly of the Huttonian day, as though *any one* could have graduated then." That this was not the case becomes evident when he says, "that the first sitting in June, 1819, of my one hundred and seventeen comrades of the year before, reduced the number to fifty-nine, the next sitting to forty-eight, and the number that got through the meshes of the sieve was but forty. Of the others, some resigned, some were 'turned back' to go over the year's course a second time, and some were found to be deficient altogether. These last were called, in the parlance of the cadets, 'Uncle Sam's bad bargains.'"

Jared Mansfield, the professor of natural and experimental philosophy, outlived Ellicott by ten years. Both were veteran surveyors and mathematicians. Mansfield retired from his chair in 1828. Mr. Latrobe says that Colonel Mansfield, "although a most competent instructor, was very near-sighted, and I am not prepared to say that this defect was not sometimes taken advantage of." Professor Church (class of 1828) says of him: "Professor Mansfield at my time was very old, yet quite enthusiastic in his branch of study, generally a mere listener to demonstrations, complimentary to a good one, but coldly silent to a bad one."

The great impulse to the study of mathematics at West Point was, however, due to younger men. One of these was Claude Crozet. After graduating at the Polytechnic School in Paris, he had been artillery officer under Napoleon. From 1816 to 1817 he was assistant professor of engineering at the Academy, and from 1817 to 1823 full professor. E. D. Mansfield has given us some interesting recollections of Crozet's earliest teaching at West Point. The Junior class of 1817-18 was the first class which commenced thoroughly the severe and complete course of studies at the Academy. Of Professor Crozet, Mansfield says that he was to teach engineering, but when he met the class he found that he would have to teach mathematics first, as not one of them had had the necessary preliminary training in pure mathematics for a course in engineering. "The surprise of the French engineer, instructed in the Polytechnique, may well be imagined when he commenced giving his class certain problems and instructions which not one of them could comprehend and perform."

Among the preliminary studies we find that descriptive geometry was included. "We do not," says E. D. Mansfield, "whether at that time more than a dozen or two professors of science in this country knew there was such a thing; *certainly* they never taught it, and equally certain there was no text-book in the English language." This science, founded by Monge, was then scarcely thirty years old. Crozet meant to begin by teaching this branch, but a new difficulty arose. Just then he had no text-book on the subject, and geometry

could not be taught orally. What was to be done? "It was here at this precise time that Crozet, by aid of the carpenter and painter, introduced the blackboard and chalk. To him, as far as we know, is due the introduction of this simple machine. He found it in the Polytechnique of France." (E. D. Mansfield).

Crozet was, however, not the first one to use the blackboard in this country. Of Rev. Samuel J. May, of Boston, it is said that, "to the work of teaching a public school he then brought one acquisition which was novel in that day, and which it has taken a half century to introduce into elementary schools, private and public—a knowledge of the uses of the blackboard, *which he had seen for the first time in 1813 in the mathematical school kept by Rev. Francis Xavier Brosius, a Catholic priest of France, who had one suspended on the wall with lumps of chalk on a ledge below and cloth hanging on either side.*"\* One thing is certain: The blackboard was introduced in this country by Frenchmen. Its importance in the school room can hardly be overestimated. Simple and inexpensive as it is, its introduction into our colleges was not instantaneous. For geometrical teaching large tablets with printed diagrams were used in our best colleges long after Crozet had taught its use at West Point.

Crozet, says E. D. Mansfield, did not more than half understand English. "With extreme difficulty he makes himself understood and with extreme difficulty his class comprehend that two planes at right angles with one another are to be understood on the same surface of the blackboard, on which are represented two different projections of the same subject." The first problems were drawn and demonstrated on the blackboard by the professor; afterward they were drawn and demonstrated by the pupils, and then carefully copied into accurate drawings.

In 1821 Crozet published his *Treatise on Descriptive Geometry*, for the use of cadets of the U. S. Military Academy (New York). The first 87 pages were given to the elementary principles, and the next 63 pages to the application of descriptive geometry to spherics and conic sections. This is, according to our information, the first English work of any importance on descriptive geometry, and the first work published in this country which exhibits to the student that gem of geometry—Pascal's Theorem.

Crozet has been called the father of descriptive geometry in this country. He taught this as preparatory to engineering. It may justly be said, also, that the course of military science was greatly developed by him.

Mr. Latrobe favors us with the following recollections of him: "There are persons whose appearance is never effaced from the memory. Of this class was the professor of the art of engineering, Col. Claude Crozet, a tall, somewhat heavily-built man, of dark complexion, black

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\* "American Educational Biography," *Barnard's Journal*, Vol. XVI, p. 141, 1866.

hair and eyebrows, deep-set eyes, remarkable for their keen and bright expression, a firm mouth and square chin, a rapid speech and strong French accent. I can, even after the lapse of between sixty and seventy years, fancy that I see the man before me. He had been an engineer under Napoleon at the battle of Wagram and elsewhere, and the anecdotes with which he illustrated his teaching were far more interesting than the 'Science of War and Fortification,' which was the name of our text book at the time. When he left the Academy he became chief engineer of the State of Virginia, which is indebted to him for the system that made her mountain roads the best, then, in America. Perhaps my recollection of Colonel Crozet is strengthened by my having seen him long after I ceased to be his pupil."

Ellicott was succeeded in the professorship of mathematics by David B. Douglass. He held it till 1823, when he was transferred to the department of engineering, where he taught till 1831. Professor Church (class of 1828) says of him: "Professor Douglass, of engineering, had the reputation of being an able engineer and a fine scholar, yet he was by no means a clear demonstrator. His style was diffuse and there was a great want of logical sequence in his language. Most of the course of engineering was given to the class by him from the black-board." He was afterward the chief engineer of the Croton water-works.

One of the text-books mentioned by E. D. Mansfield as having been used was the *Mechanics* of Dr. Gregory ("Old Greg."), who was professor at the Royal Military Academy at Woolwich. His works are collections of rules rather than expositions of principles, and are wanting in analysis. Gregory is at his best when he descends to the minutiae of practice. For several years no adequate text-book was found for civil engineering. In 1823 Major O'Connor translated a *Treatise on the Science of War* by De Vernon, which had been prepared in 1805 by the order of the French Government, and was the text-book in the polytechnic school. This translation was used at the Academy for several years. "It was a miserable translation," says General Francis H. Smith, "but it was the best that could be had, and each member of the first class was required to take a copy, costing some \$20."

After being vacated by Douglass, the chair of mathematics was taken by one whose name became known to nearly every school-boy in our land—Charles Davies. He was a native of Connecticut, graduated at the Academy in 1815, and then was made assistant professor of mathematics. He held the full professorship for fourteen years, until 1837. He earned for himself a wide reputation, not as an original investigator in mathematics, but as a teacher and as a compiler of popular text-books. He was always described by his pupils as an excellent instructor. Professor Church (class of 1828) says of him: "Professor Davies was then young, or there is to be a clear and logical demonstrator, and an admirable teacher. He had at once imbibed the spirit and fully sympathized in

the desires of the superintendent, and labored earnestly to carry them out in building up a logical system of instruction and recitation, which required not only a thorough understanding of the details of and reasons for everything proposed, but a clear, concise, and complete examination of it."

When Church was a cadet, according to his own statement, the methods of instruction were entirely new, and text-books very imperfect. The professors and teachers had themselves to learn the true use of the blackboard, and the strict and detailed manner of demonstration. In algebra the best text-book that could be obtained was a poor translation of Lacroix. In geometry we had a translation of Legendre; in trigonometry, a translation of Lacroix; in descriptive geometry, a small work by Crozet, containing only the elements without application to the intersection of surfaces or to warped surfaces. These, with the whole of shades, shadows, and perspective, stone-cutting, and problems in engineering, were given by lecture to the class. Notes were taken by the cadets, the drawings made in our rooms before the next morning, then presented for examination, and at once recited upon previous to the following lecture. The sections in mathematics, philosophy, and engineering were of twenty cadets each, and were kept in three hours daily. Biot's work on analytical geometry was used, and Lacroix's calculus.

Those who have toiled over Davies' text-books may enjoy the following reminiscences of him: "Don't you remember," says General F. H. Smith (class of 1833), "when muttering out an imperfect answer to one of his questions, how he would lean forward with one of his significant smiles and say, 'How's that, Mr. Bliss!' But I will not now dwell upon his long and faithful career in the department of mathematics. The results of his labors are to be seen in the distinguished career of his pupils and in his series of mathematical text-books, which are as household words everywhere in the United States."

When John H. B. Latrobe was a cadet, Davies was as yet only assistant professor. Latrobe speaks of him as follows: "My next professor of mathematics, in my second year's course, was one that I have no difficulty in describing and whom I can never forget, Charles Davies. Personally and mentally he was a remarkable man. Of the middle size, with a bright, intelligent face, characterized by projecting upper teeth, which procured for him the name of 'Tush' among the cadets, his whole figure was the embodiment of nervous energy and unyielding will. His fearless activity at a fire which happened in a room in the South Barracks, in 1819, added the name of 'Rush' to the other. He was a kindly natured man, too, and the patient perseverance that he devoted to the instruction of his class was not the least remarkable feature of his character. It was with Professor Davies that I began the study of descriptive geometry, for which no books in English had then been published. He had no assistance beyond the blackboard and his own intimate knowledge of the subject and faculty of oral explanation. For-



unately this was exceptionally great, and even then there was no little amount of actual labor requisite to enable the pupil to understand the difference between the horizontal and vertical planes and the uses to be made of them. It is to Professor Davies that I have always attributed in a great measure my subsequent successes at West Point, and hence this especial notice of him as a tribute to his memory. A much more enduring tribute is that awarded by the countless beneficiaries, the colleges, schools, and individuals who have profited by his numerous publications in connection with mathematical science."

Professor Davies taught for many years before he conceived the idea of issuing a series of text-books. Some of his books—as his *Legendre* and *Bourdon*—were adaptations from French works, modified to supply the wants of our schools; others were prepared on his own plan. While connected with the Academy as professor he published his *Descriptive Geometry*, 1826 (a more extensive work than *Crozet's*); *Brewster's Translation of Legendre*, 1828; *Shades, Shadows, and Perspective*, 1832; *Bourdon's Algebra*, 1834; *Analytical Geometry*, 1836; *Differential and Integral Calculus*, 1836; a *Mental and Practical Arithmetic*. Overwork in the preparation of these text-books caused bronchial affection, which forced him to resign his professorship in 1837. He visited Europe and soon after his return occupied the professorship of mathematics at Trinity College, Hartford, Conn., but ill-health again induced him to exchange the position for that of paymaster in the Army and treasurer at West Point. These offices he resigned in 1843. In 1848 he became professor of mathematics and philosophy in the University of New York, but in the following year he retired to Fishkill Landing, on the Hudson, that he might have leisure to complete his series of text-books. After teaching in the normal school at Albany, he was made professor of higher mathematics at Columbia College, in 1857.

In 1839 appeared his *Elementary Algebra*; in 1840, his *Elementary Geometry and Trigonometry*; in 1846, his *University Arithmetic*; in 1850, his *Logic of Mathematics*; in 1852, his *Practical Mathematics*; in 1855, jointly with William G. Peck, a *Mathematical Dictionary*.

Davies' series constituted a connected mathematical course, from primary arithmetic up to calculus. His books were, as a rule, perspicuous, clear, and logically arranged. They were not too difficult for the ordinary student, and contained elements of great popularity. The original editions would be found quite inadequate for the wants of schools of the present day. "The first translations of *Bourdon* and *Legendre* were imperfect" (Prof. C. W. Sears, class of 1837). Davies himself greatly modified some of his text-books in later editions. In his revisions he was greatly aided by his son-in-law, Prof. William G. Peck. The most recent revisions are those made by Prof. J. Howard Van Amringe, of Columbia College.

*Brewster's Legendre* underwent some changes in the hands of Davies. In the original work, as also in the translation of *Brewster* and *Farrar*,

each proposition was enunciated with reference to and by aid of the particular diagram used for the demonstration. But Davies gave the propositions without reference to particular figures and, to that extent, returned to the method of Euclid. In later editions Davies did not use Brewster's translation, but took the original and translated and adapted it to the courses in American schools. In trigonometry he was wedded to the line system.

The reasoning sometimes employed by Professor Davies in his books has been found to be open to objection. This is certainly true of his treatment of infinite series. In his Legendre the treatment of the circle is not such as will carry conviction to the young mind. Thus, he says in one edition, that "the circle is but a regular polygon with an infinite number of sides."\* A trained mathematician who feels that he can give more rigorous proofs by sounder methods, whenever he may wish to do so, will employ this idea of the circle, and of curves in general, with profit and satisfaction. After much study he may even arrive at the conviction that the method of limits and that of infinitesimals are essentially alike. But it is the experience of the majority of our teachers that the infinitesimal method and the treatment of the circle as a polygon appear to beginners as enigmatical and obscure. Of our more recent geometries, the best and the most popular have abandoned those methods.

Nor is Davies' explanation of a limit and of the first differential co-efficient satisfactory. Listen to the testimony of one of his pupils:† "I had not been a teacher of the calculus long . . . before I discovered that I had almost everything to learn respecting it as a rational system of thought. Difficulties were continually suggested in the course of my reflection on this subject about which I had been taught nothing, and consequently knew nothing. I found, in short, that I had only been taught to work the calculus by certain rules, without knowing the real reasons or principles of those rules; pretty much as an engineer, who knows nothing about the mechanism or principle of an engine, is shown how to work it by a few superficial and unexplained rules."

It is our opinion that under Professors Davies and Church the philosophy of mathematics was neglected at West Point. If this criticism be true of West Point, which was for several decennia unquestionably the most influential mathematical school in the United States, how much more must it be true of the thousands of institutions throughout the country which came under its influence? If this stricture were not correct, then such a book as Bledsoe's *Philosophy of Mathematics* would never have been written; there would have been no occasion for it.

Of Davies' assistants, we shall mention Lieutenant Ross. General F. H. Smith says: "There was associated with Professor Davies, . . .

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\* Davies' Legendre, 1856, Book V, Scholium to Proposition XII.

† Prof. A. T. Bledsoe, *Philosophy of Mathematics*, 1867, p. 214, note.

as his chief assistant in mathematics, having charge of the fourth class, Lieut. Edward C. Ross, of the class of 1821. He was the best teacher of mathematics I ever knew, and it is singular, too, that he had no faculty of demonstration. He gave to our class many extra discussions in the difficult points in algebra, particularly on what he called the final equations, for he was not pleased with Farrar's translation of *La Croix*, our text-book in algebra, and he was preparing his translation of *Bourdon*. In putting upon the blackboards these extra demonstrations every line appeared as if it had been printed, so neat was he in the use of his chalk pencil. But when he commenced to explain he would twist and wriggle about from one side of the board to the other, pulling his long whiskers, and spitting out, in inordinate volumes, his tobacco juice. The class was as ignorant when he closed as when he began. We copied, word for word, what was written, well knowing that on the next day the first five would be called upon to make the discussion. We read to him what we had placed on the board. Then commenced his power as a teacher. In a series of orderly questions he would bring out the points of the discussion, step by step, sometimes occupying half an hour with each cadet, and when the three hours of recitation were over we knew the subject thoroughly. He was an expert in his power of questioning a class. He did this without note or book, and gave such earnestness and vividness to his examinations that he kept his class up to the highest pitch of interest all the time."

General Smith gives us a description also of Courtenay. "Edward H. Courtenay, who graduated at the head of Ross's class, was our professor of natural and experimental philosophy, fifty years ago. There never was a clearer minded—a more faithful teacher—or a more modest one than Professor Courtenay. Well do I remember the hesitating manner with which he would correct the grossest error on the part of a member of his section—I hardly think so. He resigned his professorship in 1834, and after holding many offices of high dignity, as professor and civil engineer, he was elected professor of mathematics in the University of Virginia in 1842."

Courtenay was instructor at West Point from 1821 to 1834, excepting the four years from 1824 to 1828. During his first years of teaching he was assistant professor of natural and experimental philosophy, and then assistant professor of engineering. After the resignation of Jared Mansfield he was appointed professor of natural and experimental philosophy, and acted in that capacity for five years. In 1833 he translated from the French of M. Bouchariat an elementary treatise on mechanics, and made additions and emendations.

The chair of military and civil engineering, made vacant by the resignation of Professor Douglass, was filled by the appointment of Lieut. Dennis H. Mahan. Mahan graduated at West Point in 1824, holding the first place in his class of thirty-one members. "After remaining at the Academy as an instructor for two years, he was ordered to Europe

to study public engineering works and military institutions. By special favor of the French Ministry of War, Lieutenant Mahan was allowed to join the Military School of Application for Engineers and Artillerists at Metz, where he remained for more than a year, under the instruction of men whose names were then, and are now, widely known in science.\* When, after his return, he entered upon the duties of his department at West Point, he supplemented the meagre volume of O'Connor with extensive notes. These notes developed into his well-known treatises on Civil Engineering and Field Fortifications.

Such is the brief record of the professional career of Professor Mahan; but it fails to convey any adequate idea of the influence which he exerted upon engineering science in this country. To appreciate this, it must be remembered that for many of those forty-one years (during which he was professor) West Point was our only school of mathematical and physical science where the rigid requirements and high standard now deemed essential were even attempted. Every officer of the present corps of engineers who has served long enough to win reputation in the performance of the civil duties assigned to that corps, and many of the eminent civil engineers of the country as well, now gratefully remember how, before those old blackboards in that unpretending recitation room at West Point, they learned from Professor Mahan, with the rudiments of their profession, a high-toned discipline and the fundamental truth that without precision of ideas, rigid analysis, and hard work there can be no such thing as success.

"But if civil engineering owes much to our late colleague, military engineering and the science of war owe more. For many years, and up to the day of his death, he was in that branch of the profession confessedly the highest scholastic authority in America.\*"

The death of Mahan was pathetic. In his last years he often had fits of melancholy, and, in an instant of acute insanity, he plunged from a steamer into the Hudson and drowned.

Professor Davies was succeeded in the chair of mathematics by Prof. Albert E. Church. Church was a native of Connecticut, graduated at West Point in 1828, served as assistant professor from 1828 to 1831, also from 1833 to 1837. He was then acting professor of mathematics for about a year, and in 1838 he became full professor, retaining the chair till his death in 1878. He published four works which have been used considerably in American colleges. His *Differential and Integral Calculus*, 1842, was more extensive than that of Davies. In the new edition of 1851 a chapter on the *Elements of the Calculus of Variations* was inserted. In 1851 appeared his *Analytical Geometry*, in which he followed somewhat the work of Blot on this subject. In 1857 his *Plane and Spherical Trigonometry* was published. In 1865 appeared his *Elements of Descriptive Geometry*, in the preparation of which he was

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\* *Biographical Memoirs of the National Academy of Sciences*, Vol. II, 1886, p. 32.

aided by the French works of Leroy and Oliver, and by the elaborate American work of Warren. Later editions give also the application of the subject to shades, shadows, and perspective. The *Descriptive Geometry* met with larger sales than any of his other works.

As a teacher, Professor Church is spoken of by General F. H. Smith as follows: "Prof. Albert E. Church was an assistant professor of mathematics when my class entered in 1829. He occasionally heard my section in the third class course and exhibited then the clearness and perspicuity which marked his long career as a professor of mathematics."

Prof. Arthur S. Hardy (class of 1869) gives the following reminiscences of the mathematical teaching in his day:\*

"The class was divided into sections of from ten to fifteen. The alphabetical arrangement, first adopted, became in a few weeks a classification by scholarship—transfers up and down being made weekly. The descent was easy, but it was hard to rise a section. The last section we called *Les Immortels* (lazy mortals?). In each section each student recited daily. The sections were taught by army officers detailed at Professor Church's request. The latter had no section, but generally visited each daily. Each recitation was one hour and a half long. Professor Church's visits were dreaded. He usually asked questions. His questioning was searching. He was a stickler for form—it was not enough to *mean* right.

"Personally he did not inspire me; he had no magnetism—was dry as dust, as his text-books are. He delivered one lecture on the calculus. I never got a glimpse of the philosophy of mathematics—of its history, methods of growth. The calculus was a machine, where results were indisputable, but its mechanism a mystery. I do not think he had a great mathematical mind. It was geometrical, rather than an analytic one. A problem, which he and Professor Bartlett once attacked together, the latter solved by a few symbols on a piece of paper, while the former drew a diagram with his cane on the gravel—to Bartlett's disgust, who despised geometry. Church's text-books are French adaptations, minus the luminousness and finish of form of French text-books.

"The only instance of Church's being disconcerted was on being told by a cadet that the reason for  $+$  becoming  $-$  in passing through zero was that the cross-piece got knocked off in going through. You can imagine that the would-be wit was placed in arrest.

"The mathematical recitation at West Point was a drill-room. In my judgment its result was a soldier who knew the manœuvres, but it did not give an independent, self-reliant grasp of methods of research. In descriptive geometry, the Academy had a magnificent collection of models, but they were shown us *after* the study was finished—in other words, mental discipline was the object—practical helps and ends were secondary. Great changes have been made since."

William H. C. Bartlett (class of 1826) was assistant professor for

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\*Letter to the writer, November 12, 1888.

several years at West Point. He was permanently appointed professor of natural and experimental philosophy in 1836. In 1871 he was retired from military service at his own request, and shortly after he accepted the place of actuary for the Mutual Life Insurance Company of New York.

The need of an astronomical observatory being felt at West Point, Professor Bartlett went abroad in 1840 to order instruments and visit observatories. On his return it was necessary to provide room for the instruments in the new library building of the school, on account of the great prejudice existing in Congress against a separate observatory.\*

Bartlett published treatises on Optics, 1839; Acoustics; Synthetic Mechanics, 1850; Analytical Mechanics, 1853; Spherical Astronomy, 1855. He contributed also to Silliman's Journal. His Analytical Mechanics is the first American work of its kind which starts out with, and evolves everything from, that precious intellectual acquisition of the nineteenth century—the laws of the indestructibility of matter and energy. Dr. R. S. McCulloch (who, by the way, rewrote Bartlett's Mechanics without allowing his own name to appear anywhere in the revised edition) says:† “More than thirty years ago, at West Point, Professor Bartlett, in his treatise on Analytical Mechanics, still used there as a text-book, had deduced the whole science from one single equation, or formula, well known to every cadet as his equation  $A$ ; and he thus expressed and discussed fully what now is generally called the Law of the Conservation of Energy.”

Bartlett's successor was Prof. Peter S. Michie, the present incumbent in the chair. Michie graduated in 1863, and has been instructor there since 1867. He has published Wave Motion, Relating to Sound and Light, 1882; Hydrostatics; and Analytical Mechanics, 1886. The first edition of the last treatise was never published; the second edition, 1887, differs considerably from the first. It is on the plan of Bartlett's book on the same subject, but it is confined to mechanics of solids. It contains also a good introduction to graphical statics, a subject which, in recent years, has come to be studied in this country. The first to place a treatise on graphical statics in the hands of American engineers was A. Jay Du Bois,‡ professor at Lehigh University, Pa. This subject owes its development chiefly to Culmann, who, in 1866, published in Zurich his *Graphische Statik*. In technical schools in Europe this method has been favorably received. In this country original contributions of great value have been made to this subject by Prof. Henry T. Eddy, of the University of Cincinnati.§

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\* The Development of Astronomy in the United States, by Prof. T. H. Safford 1888, p. 19.

† Papers read before the New Orleans Academy of Sciences, 1856-57, Vol. I., No. 1, p. 120.

‡ The Elements of Graphical Statics and their Application to Framed Structures, New York, 1875.

§ Van Nostrand's Engineering Magazine, 1878. Article: “A New General Method in Graphical Statics.”

In 1841 Professor Church was aided in his department by five assistants. This number has been increased since, and is now nine. These assistants have been, we believe, always selected from young graduates of the Academy. The course of study in pure and applied mathematics was, in 1841, as follows: *Fourth Class* (first year), Davies' *Bourdon*, Legendre, and Descriptive Geometry; *Third Class*, Davies' works on Shades and Shadows, Spherical Projections and Warped Surfaces, Surveying, Analytical Geometry, and Calculus; *Second Class*, Courtenay's Boucharlat's *Traité de Mécanique*, Roger's Electricity, Magnetism, Electro Magnetism and Electro-Dynamics, Bartlett's Optics, Gummere's Astronomy; *First Class*, Mahan's Treatises on Field Fortifications, Lithographic Notes on Permanent Fortification, Attack and Defence, Mines and other Accessories, Composition of Armies, Strategy, Course of Civil Engineering, Lithographic Notes on Architecture, Stone Cutting, Mechanics (studied by the first section only).

As Church's and Bartlett's text-books came from the press they were introduced in place of earlier ones. Thus, Davies' Geometry, Calculus, Descriptive Geometry, and Trigonometry, Gummere's Astronomy, and Courtenay's Boucharlat's Mechanics were gradually displaced by new books. But some of Davies' books have been retained to the present day. We may here state that the power of selecting text-books does not lie with each individual professor, but with the Academic Board.

After the death of Mahan, in 1871, the chair of military and civil engineering was given to Junius B. Wheeler, of the class of 1855. He retired in 1884, and was succeeded by James Mercur. Professor Wheeler gradually substituted books of his own in place of Mahan's treatises.

Professor Church's successor is Prof. Edgar W. Bass, of the class of 1868. By him more attention is given to the philosophical exposition of fundamental principles than was given by his predecessors. Davies' and Church's text books are still used, but they are much modified by copious notes by Professor Bass. In calculus the notation of Leibnitz has always been used, but now the Modern is also given. At present the calculus is based upon the Newtonian conception of rates, but his notation is not used. In 1879 determinants and least squares were introduced into the course of study, Peck's *Determinants* and Chauvenet's *Least Squares* being the text-books used.

The present mode of instruction in mathematics involves recitations by cadets at the blackboard, lectures and explanation of the text, numerous applications of each principle, and written recitations by the students. The sections number from nine to twelve students, for one and a half hours' instruction. Three hours are allotted for the study of each mathematical lesson. Recitations are daily, Sundays excepted.

The course of study for 1888 is as follows: *Fourth class*, Davies' elements of Algebra, Legendre's Geometry, Lindlow's Elements of Trigonometry, Davies' surveying, Church's Analytical Geometry; *Third class*,

Church's Analytical Geometry, Descriptive Geometry with its applications to Spherical Projections, Bass's Introduction to the Differential Calculus, Church's Calculus, Church's Shades, Shadows, and Perspective, Chauvenet's Treatise on the method of Least Squares; *Second class*, Michie's Mechanics, Bartlett's Astronomy, Michie's Elements of Wave Motion relating to Sound and Light; *First class*, Wheeler's Civil Engineering, Field Fortifications, Mercur's Mahan's Permanent Fortifications (edition of 1887); Wheeler's Military Engineering (Siege Operations and Military Mining), Elements of the Art and Science of War, and Mahan's Stereotomy. For reference, is used a book called Royal Engineers' Aide-Memoire, Parts I and II.

It may be stated, in conclusion, that the U. S. Military Academy has contributed to the educational force of the country no less than thirty-five presidents of universities or colleges, twenty-seven principals of academies and schools, eleven regents and chancellors of educational institutions and one hundred and nineteen professors and teachers, making a total of one hundred and ninety-two instructors of youth distributed throughout the country.\*

#### HARVARD COLLEGE.

In 1807 John Farrar succeeded Samuel Webber in the chair of mathematics and natural philosophy. Farrar was a native of Massachusetts. After graduating at Harvard he studied theology at Andover, but having been appointed tutor of Greek, in 1805, he never entered the ministerial office. He retained his chair till 1836, when he resigned in consequence of a painful illness that finally caused his death. He was a most amiable, social, and excellent man, and endeared to his friends. By the students he was familiarly called "Jack Farrar."

Prof. Andrew P. Peabody gives the following reminiscences of him: † "He delivered, when I was in college, a lecture every week to the Junior class on natural philosophy, and one to the Senior class on astronomy. His were the only exercises at which there was no need of a roll-call. No student was willingly absent. The professor had no notes, and commenced his lecture in a conversational tone and manner, very much as if he were explaining his subject to a single learner. But whatever the subject, he very soon rose from prosaic details to general laws and principles, which he seemed ever to approach with blended enthusiasm and reverence, as if he were investigating and expounding divine mysteries. His face glowed with inspiration of his theme. His voice, which was unmanageable as he grew warm, broke into a shrill falsetto; and with the first high treble notes the class began to listen with breathless stillness, so that a pin-fall could, I doubt not, have been heard through the room. This high key once reached there was no return to the lower

\*Annual Report of the Board of Visitors to the U. S. Military Academy made to the Secretary of War, for the year 1886.

†Harvard Reminiscences, by Andrew P. Peabody, Boston, 1888, p. 70.



notes, nor any intermission in the outflow and quickening rush of lofty thought and profound feeling, till the bell announced the close of the hour, and he piled up all the meaning that he could stow into a parting sentence, which was at once the climax of the lecture, and the climax of an ascending scale of vocal utterance higher, I think, than is within the range of an ordinary soprano singer. I still remember portions of his lectures, and they now seem to me no less impressive than they did in my boyhood."<sup>1</sup>

Josiah Quincy † says in his diary, which he kept while a student at college, that by the prolixity of Professor Everett in his lectures, "we gained a miss from Farrar for the fourth time this term. This was much to the gratification of the class, who in general hate his branch, though they like him."

Professor Farrar did not distinguish himself by original research in mathematics, but he was prominent and among the first to introduce important reforms in the mathematical teaching in American colleges. He was the first American to abandon English authors and to place translations of Continental works on mathematics in the hands of students in the New World.

In 1818 appeared Farrar's Introduction to the Elements of Algebra, selected from the Algebra of Euler. Notwithstanding the transcending genius of Euler as a mathematician and the high estimation he was held on the Continent, his algebra was scarcely to be met with previous to this time, either in America or England. It was written by the author after he became blind, and was dictated to a young man entirely without education, who by this means became an expert algebraist. Farrar's Euler was a very elementary book, and was intended for students preparing to enter college. It differed from the English works in this, that it taught pupils to reason, instead of to memorize without understanding.

In the same year appeared also Farrar's translation of the Algebra of Lacroix, which was first published in France about twenty years previously. Lacroix was one of the most celebrated and successful teachers and writers of mathematical text-books in France. Farrar translated also Lacroix's Arithmetic, but this does not appear to have been

<sup>1</sup>Dr. John DeForest quotes his reminiscences as follows: "I recall distinctly a lecture given by the erstwhile, in its various aspects, the idea that in mathematical sciences, and that a wise man sees things precisely as God sees them, handles the very scale and compass with which the Creator planned and built the universe; another in which he represented the law of gravitation as coincident with, and demonstrative of, the law of divine justice; another, in which he made us almost hear the music of the spheres as they circled the grand procession, in infinite space and in immeasurable time, of our own system and the (so-called) fixed stars. His lectures were poetical, but the poems in prose; for his language was unconsciously rhythmical, and his sentences were like a temple chant."

<sup>2</sup>Quincy, *op. cit.*, 1837, p. 1.

<sup>3</sup>North American Review, 1-15.

received as favorably in this country as the other works of the Harvard professor.

In 1819 was published at Cambridge the Geometry of that famous French mathematician, Legendre. A similar translation was made in England by David Brewster. Legendre has been the greatest modern rival of Euclid. In France, in most schools in America, and in some English institutions, the venerable and hoary-headed Euclid was made to withdraw and make room for Legendre.

If the question be asked, what is the difference between the geometries of Euclid and Legendre, we would answer that the main object of Legendre was to make geometry easier and more palatable to students. This he succeeded in doing, but at a sacrifice of scientific rigor. The following are the principal points of difference between Euclid and Legendre: (1) Legendre treats the theory of parallels differently; (2) Legendre does not give anything on proportion, but refers the student to algebra or arithmetic. The objection to this procedure is that in arithmetic and algebra, the properties of proportion are unfolded with regard to numbers, but *not* with regard to magnitude in general. From a scientific point of view this is a serious objection, especially if we remember that in geometry incommensurable quantities arise quite as frequently as commensurable quantities do. Euclid's treatment of proportion displays wonderful skill and rigor, but is very difficult and abstract for students beginning the study of geometry; (3) Euclid never supposes a line to be drawn until he has first demonstrated the possibility and shown the manner of drawing it. Legendre is not so scrupulous, but makes use of what are called "hypothetical constructions." (4) Legendre introduces new matter, especially in solid geometry, changes the order of propositions, and gives new definitions (as, for instance, his definition of a straight line).

In 1820 Farrar published his translation of Lacroix's Trigonometry. The original gave the centesimal division of the circle, but in the translation the sexagesimal notation was introduced. This trigonometry adopted the "line system." Bound together with this book was the "Application of Algebra to Geometry." This was selected from the Algebra of Bezout. Regarding this selection Professor Farrar says: "It was the intention of the compiler to have made use of the more improved treatise of Lacroix or that of Biot upon this subject; but as analytical geometry has hitherto made no part of the mathematics taught in the public seminaries of the United States, and as only a small portion of time is allotted to such studies, and this is in many instances at an age not sufficiently mature for inquiries of an abstract nature, it was thought best to make the experiment with a treatise distinguished for its simplicity and plainness."\*

The next book in the "Cambridge Course of Mathematics," as Farrar's works were called, was an Elementary Treatise on the Application

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\* See advertisement to the Treatise.

of Trigonometry (1828), in the preparation of which were used Cagnoli's and Bonnycastle's Trigonometries, Delambre's Astronomy, Bezout's Navigation, and Puissant and Malortie's Topography.

In 1824 were published the First Principles of the Differential and Integral Calculus, "taken chiefly from the mathematics of Bezout." This is the first text book published in America on the calculus and employing the notation of Leibnitz. It is based on the infinitesimal method. Bezout flourished in France before the Revolution. His works were, therefore, at this time, rather old, but his calculus was selected in preference to others "on account of the plain and perspicuous manner for which the author is so well known, as also on account of its brevity and adaptation in other respects to the wants of those who have but little time to devote to such studies."\*

The introduction is taken from Carnot's *Réflexions*, and gives the explanation by the "compensation of errors."

The translation of Bezout's calculus is only in part the work of Professor Farrar. After having begun it, he was obliged to go to the Azores, on account of the health of his wife, and the translation was completed by George B. Emerson. He had it printed with his introduction and notes, so that when Professor Farrar returned he found it ready for use in the college.†

Farrar's translations and selections from French authors were at once adopted as text-books in some of our best institutions. Several books in the series were used at the U. S. Military Academy and at the University of Virginia.

The professor of mathematics and natural philosophy was always assisted by tutors. They generally taught the pure mathematics to the lower classes. In 1825 there were three. One of them, James Hayward, had been tutor for five years, and had striven to reform the teaching of elementary geometry. He was made professor in 1826, but a year later he severed his connection with the college and engaged in civil engineering, in which he became a high authority. The original survey of the Boston and Providence Railway was made by him. Among the other tutors of note who served during the time of Professor Farrar were Thomas Sherwin, A. P. Peabody, and Benjamin Peirce. Dr. Peabody is now Plummer professor of Christian morals, emeritus. Among Harvard men of Farrar's time are also Charles Henry Davis, who afterward served on the Coast Survey and established the American Ephemeris, and Sears Cook Walker, who, later, became a noted astronomer.

We now proceed to inquire into the terms for admission and the courses of study. Since 1816 the whole arithmetic has been required for admission to Harvard College. In 1819 a trifling amount of algebra was added. The catalogue of 1825 specifies the requirements as follows:

\*Advertisement to the translation.

† *Barnard's Journal*, 1875, "Schools as They Should Be," by George B. Emerson.

"Fundamental rules of arithmetic; vulgar and decimal fractions; proportion, simple and compound; single and double fellowship; alligation, medial and alternate; and algebra to the end of simple equations, comprehending also the doctrine of roots and powers, and arithmetical and geometrical progression." The books used in the examination were the Cambridge editions of Lacroix's Arithmetic and Euler's Algebra. In 1841 Euler's Algebra or the First Lessons in Algebra were required. No other changes were made until 1843. The catalogue for that year mentions for admission Davies' First Lessons in Algebra to "Extraction of Square Root;" and "An Introduction to Geometry from the most approved Prussian text-books, to VII.—Of Proportions." No other subjects were added until 1866-67, though there were some changes in the text-books. In 1850 Davies' and Hill's Arithmetics are mentioned; in 1853 Davies' and Chase's Arithmetics; in 1859 Davies', Chase's, or Eatou's Arithmetics, Euler's Algebra, or Davies' First Lessons, or Sherwin's Common School Algebra, and the Introduction to Geometry; in 1865 Chase's Arithmetic, Sherwin's Algebra, Hill's Second Book in Geometry, Parts I and II, or "An Introduction to Geometry as the Science of Form" as far as p. 130.

In addition to these statements taken from catalogues it will be interesting to add the following account, given by Prof. William F. Allen, of the class of 1851: \* "The requirements for admission were not much above a common school. That is, I got my arithmetic and algebra in a country district school (well taught). Geometry I picked up for myself in a very small quantity. I remember at the entrance examination I was asked what an angle was. I thought I knew, but I think I convinced the examiner that I didn't; however, I got in clear."

During the first ten or eleven years of his teaching Professor Farrar used the books of Samuel Webber. A second edition of Webber's Mathematics appeared during Professor Farrar's incumbency. In 1818 the course of study in mathematics was as follows:† *Freshmen*, algebra and geometry, during the first and second term and three weeks of the first term. *Sophomores*, algebra, trigonometry and its applications to heights and distances, and navigation during the third term. *Juniors*, natural philosophy and astronomy (Enfield's), mensuration of superficies and solida, and surveying during the third term. In place of Hebrew, on the written request of their parents or guardians, students were permitted to attend to mathematics with the private instructor, or Greek, or Latin, or French; *Seniors*, conic sections and spherical geometry during the first term and half of the second. We are informed, moreover, that for the attendance on the private instructor in mathematics, which was optional, there was a separate charge, at the rate of \$7.50 per quarter.

There was a public examination of each class in the third term and a

\* Letter to the writer, November 6, 1888.

† North American Review, March, 1818.

public exhibition of performances in composition, elocution, and in the mathematical sciences, three times a year. Prizes were also given. The Bowdoin prize dissertation was read in the Chapel in the third term. Of these prizes, the first premium was given in 1815 to Jared Sparks, of the Senior class, for a dissertation "On the character of Sir Isaac Newton, and the influences and importance of his discoveries." The title of this essay would show that Sparks had, very probably, studied fluxions, though this branch was not included in the curriculum for 1818, given above. Fluxions never had been a regular study, obligatory upon all the students, though provisions seem to have been made for those wishing to prosecute it.

During the twenty-nine years that Farrar was professor, from 1807 to 1836, 275 theses were written by students on mathematical subjects at Harvard, and deposited in the library of the college. Of these about one-fourth contain solutions of fluxional problems (or problems involving the differential and integral calculus); a little less than one-half are on the calculation and projection of eclipses; the remaining on algebra, mechanics, surveying, etc. Many of these papers are interesting memorials of men since become in different degrees famous. Thus George Bancroft wrote, in 1817, a thesis, "Invenire Motum Verum Modorum Lunæ;" George B. Emerson, on "Fluxional Solutions of Problems in Harmonicks" (1817); Warren Colburn, on "Calculation of the Orbit of the Comet of 1819;" Sears Cook Walker, in 1825, on "The Transit of Venus in 1822," and "The Effect of Parallax upon the Transit in 1822;" Benjamin Peirce, in 1828, on "Solutions of Questions . . . from the Mathematical Diary, etc.;" Wendell Phillips, in 1831, on "Some Beautiful Results to which we are Led by the Differential Calculus in the Development of Functions."\*

The catalogue for 1820 shows that Webber's Mathematics and Euclid's Geometry had been discarded. Farrar's new books came now to be used. The Freshmen studied Legendre's Geometry and Lacroix's Algebra. Analytic methods began to acquire a foothold. Conic sections were displaced by analytic geometry, which, with trigonometry, was begun in the Sophomore and concluded in the Junior year. The Catalogues from 1821 to 1824, inclusive, do not give the course of study. In 1824 the Juniors studied, during the second term, differential calculus from Bezout's work, unless they exercised their privilege of electing modern languages in place of mathematics. The catalogue of 1830 shows some slight changes in the course. The Freshmen studied Legendre's Plane Geometry, algebra, solid geometry; the Sophomores, trigonometry and its applications, topography, and calculus; the Juniors, natural philosophy and mechanics in the second term, and electricity and magnetism in the third term; the Seniors, optics and natural philosophy.

The following remarks by Dr. Peabody applying to this period are

\* "Matriculation Theses of Junior and Senior Classes, 1792-1839, by Henry C. Badger. *Bibliothèque et Contributions of the Library of Harvard College*, No. 32.

instructive: "The chief labor and the crowning honor of successful scholarship were in mathematics and the classics. The mathematical course extended through the entire four years, embracing the differential calculus, the mathematical treatment of all departments of physical science then studied, and a thoroughly mathematical treatise on astronomy. (Gummere's, afterward replaced by Farrar's almost purely descriptive treatise."\*)

The year 1832 marks an epoch in the history of mathematical teaching at Harvard. It was then that Benjamin Peirce became professor of mathematics and natural philosophy.

While there had been men in this country who had cultivated mathematics with ardor, they had seldom possessed the talent and aspirations for original research in this science. We have had many who were called "mathematicians," but if this name be used in the highest sense, and be conferred upon only such persons as have been able to discover mathematical truths not previously known to man, then it can fall upon very few Americans. The mere ability of mastering the contents of even difficult mathematical books, or of compiling good school-books in this science, does not make him a mathematician worthy of standing by the side of Legendre, the Bernoullis, Wallis, Abel, Tartaglia, or Pythagoras—to say nothing of such master minds as Archimedes, Leibnitz, and Newton. But at last we have come to a name which we may pronounce with pride as being that of an American *mathematician*. We need not hesitate to rank along with the names of Wallis and John Bernoulli that of Benjamin Peirce.

It has been said that a young boy detected an error in the solution given to a problem by Nathaniel Bowditch. "Bring me the boy who corrects my mathematics," said Bowditch, and Benjamin Peirce, thirty years later, dedicated one of his great works "To the cherished and revered memory of my master in science, Nathaniel Bowditch, the father of American Geometry." The title of "father of American Geometry," which Peirce confers upon his beloved master, has been bestowed by foreign mathematicians upon Peirce himself. Sir William Thomson referred, in an address before Section A of the British Association, to Peirce as, "the founder of high mathematics in America." On a similar occasion Arthur Cayley spoke of him as the "father of American mathematics."

Benjamin Peirce was born at Salem in 1809. He entered Harvard College at the age of sixteen, and devoted himself chiefly to mathematics, carrying the study far beyond the limits of the college course. Thus he attended lectures on higher mathematics by Francis Grund. While an under-graduate he was a pupil of Nathaniel Bowditch, who perceived the genius of the young man and predicted his future greatness. Bowditch directed him in the development of his scientific

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\* Harvard Reminiscences, by A. P. Peabody, p. 203.

powers, and gave him valuable instruction in geometry and analysis. When Bowditch was publishing his translation and commentary of the *Mécanique Céleste*, Peirce helped in reading the proof-sheets, and thereby contributed greatly toward rendering it free from errors. This critical reading of that great work of Laplace must have been an education to him in itself. Indeed, a great part of Peirce's scientific labors was in the field of analytic mechanics.

Dr. Peabody gives the following reminiscences of Peirce: \* "While Benjamin Peirce the younger was still an under-graduate . . . it was said that in the class-room he not infrequently gave demonstrations that were not in the text-book, but were more direct, summary, or purely scientific than those in the lessons of the day. College classes were then farther apart than they are now; but even in our Senior year we listened, not without wonder, to the reports that came up to our elevated platform of this wonderful Freshman, who was going to carry off the highest mathematical honors of the university. On graduating, he went to Northampton as a teacher in Mr. Bancroft's Round Hill School, and returned to Cambridge in 1831 as tutor. The next year the absence of Professor Farrar in Europe left him at the head of the mathematical department (which he retained till his death), the following year receiving the appointment of professor; while Mr. Farrar on his return was still unable to take charge of class instruction."

In 1842 Peirce was appointed Perkins professor of astronomy and mathematics. This position he held until his death, in October, 1880. Tutor Henry Flint is the only person ever connected with the college for a longer time.

We shall first speak of the mathematical text books written by Peirce, then of his record as a teacher, and, lastly, of his original researches.<sup>†</sup>

As soon as he entered upon his career as teacher of mathematics at Harvard he began the preparation of mathematical text-books. In 1831 appeared his *Elementary Treatise on Plane Trigonometry*, and in 1836 his *Elementary Treatise on Spherical Trigonometry*. The two were published in a single volume in later editions. In 1836 appeared also his *Elementary Treatise on Sound*; in 1837, his *Elementary Treatise on Plane and Solid Geometry* and his *Elementary Treatise on Algebra*; during the period 1841-46 he wrote and published in two volumes his *Elementary Treatise on Curves, Functions, and Forces*; in 1855, was published his *Analytical Mechanics*.

Rev. Thomas Hill, ex President of Harvard and an early pupil of Peirce, speaks of these books as follows: "They were so full of novelties that they never became widely popular, except, perhaps, the *Trigonometry*; but they had a permanent influence upon mathematical teaching in this country; most of their novelties have now become common-places in all text-books. The introduction of infinitesimals or of limits

\* *Harvard Reminiscences*, p. 1-1.

† We shall draw freely from the Memorial Collection, by Moses King, 1881.

into elementary books; the recognition of direction as a fundamental idea; the use of Hassler's definition of sine as an arithmetical quotient, free from entangling alliance with the size of the triangle; the similar deliverance of the expression of derivative functions and differential co-efficients from the superfluous introduction of infinitesimals; the fearless and avowed introduction of new axioms, when confinement to Euclid's made a demonstration long and tedious—in one or two of these points European writers moved simultaneously with Peirce, but in all he was an independent inventor, and nearly all are now generally adopted."

The ratio system in trigonometry was used before this by Hassler in his masterly, but ill-appreciated, work on Analytic Trigonometry, and also by Charles Bonnycastle in his Inductive Geometry. But this system met with no favor among teachers. The most popular works on trigonometry, such as the works of Davies and Loomis, as also those of Smyth, Hackley, Robinson, Brooks, and Olney, adhered to the old and obsolete "line system," and it was not till within comparatively recent years that the "ratio system" came to be generally adopted. The old "line system" was brought to America from England, but the English discarded it earlier than we did. In 1849 De Morgan wrote that the old method of defining trigonometric terms was universal in England until *very lately*.

The final victory of the system in this country is due chiefly to the efforts of Peirce, Chauvenet, and their followers. It is significant that Loomis, in a late edition of his trigonometry, has been driven by the demands of the times to abandon the old system.

The advisability of using infinitesimals and the idea of direction in elementary text-books will be discussed in another place.

About the beginning of the second quarter of this century considerable dissatisfaction came to exist among the public about the college system as it was then conducted in this country. The people demanded a change from the old scholastic methods. Then for the first time arose the now familiar cry against forcing the ancient languages upon all students entering college. It was demanded that greater prominence be given to modern languages, to English literature, to practical mechanics, and that the student should have some freedom in the selection of his studies. Though some few modifications were made here and there in the college courses, the "New Education" did not secure a firm hold upon our colleges until the third quarter of the present century.

In these reforms Harvard has always taken a prominent part. The elective system there has been traced back to 1824, when Juniors could choose a substitute for 38 lessons in Hebrew, and Seniors had the choice between chemistry and fluxions. Benjamin Peirce was an enthusiastic advocate of the elective system.

We now proceed to give the courses in mathematics during the early



part of Peirce's connection with the college. His own text-books were adopted as soon as they came from the press. In 1836 and 1837 the Freshmen used Walker's Geometry, Snyth's Algebra, Peirce's Plane and Spherical Trigonometry; the Sophomores, Farrar's books on Analytical Geometry, Calculus, and Natural Philosophy; the Juniors continued the Natural Philosophy.

In the catalogue for 1838 we notice important changes. The Freshmen studied Peirce's Geometry and Algebra; the Sophomore class was divided into three sections, of which the first pursued practical mathematics, including mensuration, dialing, construction of charts, surveying, the use of globes and instruments in surveying, during the first term; and during the second term the general principles of civil engineering, nautical astronomy, and the use of the quadrant. This section was evidently intended to meet the demands of the time for practical knowledge, without having first laid a broad and secure theoretical foundation. But little could be accomplished in civil engineering without a knowledge of calculus. The second section reviewed arithmetic, geometry, and algebra; then took up conic sections, fluxions, and the mathematical theory of mechanics. The third section, intended for students of mathematical talents and taste, pursued analytic geometry, theory of numbers and functions, differential and integral calculus, and mechanics.

But this arrangement did not prove satisfactory. The facts are that Professor Peirce's text-books were found very difficult, and Peirce himself was not a good teacher, except for boys of mathematical genius. Peirce was anxious to introduce the elective system, so that students without mathematical ability would not be forced to pursue mathematics beyond their elements. In May, 1838, a vote was passed, permitting students to discontinue their mathematics at the end of the Freshman year if they chose to. The catalogue for 1839 announced that "every student who has completed during the Freshman year the studies of geometry, and algebra, plain trigonometry with its applications to heights and distances, to navigation, to surveying, and that of spherical trigonometry, and who has passed a satisfactory examination in each to the acceptance of the mathematical department and a committee of the overseers—may discontinue the study of mathematics at the end of the Freshman year, at the written request of his parent."

Referring to these changes the president said, the following year, that the liberty to discontinue mathematics at the end of the year had been found highly acceptable to both students and parents and had, thus far, been attended by no ill consequences; that elections in the secondary course had had a tendency to encourage those capable of profiting by the study of that branch; that those possessing mathematical talent were stimulated; that of fifty five, only eight continued mathematics; and that the head of the department considered the voluntary system *superior*. The difficulties in the mathematical course for the Sopho-

mores seemed to be removed. But how about the Freshmen? Mathematical studies were not popular with them; they complained of overwork. In 1839 the committee on studies reported that "the mathematical studies of the Freshman class are so extensive as to encroach materially upon the time and attention due to other branches," and proposed to remove the time when mathematical studies may be discontinued, from the end of the Freshman to the first term of the Sophomore year.

The catalogue for 1838-39 gives no mathematics for the Junior and Senior years. The following year Peirce's Treatise on Sound was studied by the Juniors. In 1841 an extended mathematical course was offered in the Junior and Senior years. The Juniors were to study Peirce's Treatise on Sound and the Calculus of Variations and Residuals; the Seniors, Poisson's Mécanique Analytique and Celestial Mechanics. The number of students venturing to enter such difficult but enchanted fields of study were but few. In 1843 there were only two sections instead of three as before. One was called the course in Practical Mathematics, comprising Peirce's Plane and Spherical Trigonometry; the other was called the course in Theoretical Mathematics, in which Peirce's Algebra was concluded, and his Curves, Functions, and Forces, studied as far as "Quadratic Loci." These two courses continued through the Junior and Senior years. The studies offered varied somewhat from year to year.

In obedience to the practical demands of the times, the Lawrence Scientific School was opened in 1842 as a branch of Harvard. It began as a school of chemistry. But by the year 1847 the plan of this school was broadened so as to embrace other sciences. "There shall be established in the University an advanced school for instruction in theoretical and practical science and in other usual branches of academic learning." Instruction was to be given by Professor Horsford in chemistry, by Professor Agassiz in zoölogy and geology, by Professor Lovering in experimental philosophy, by William Bond in practical astronomy, and by Professor Peirce in higher mathematics, especially in analytical and celestial mechanics. The course offered by Professor Peirce to students in this school, in 1848, was as follows:

## COURSE IN MATHEMATICS AND ASTRONOMY.

## I.—CURVES AND FUNCTIONS.

| <i>Regular course.</i>                                           | <i>Parallel course.</i>                                                                            |
|------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| PEIRCE. Curves and Functions.                                    | BIOT. Géométrie Analytique.                                                                        |
| LA CROIX. Calcul Différentiel et Intégral.                       | CAUCHY. Cours d'Analyse de l'École Royale Polytechnique.                                           |
| CAUCHY. Les Applications du Calcul Infinitésimal à la Géométrie. | HAMILTON's researches respecting quaternions. (Transactions of the Royal Irish Academy, Vol. XXI.) |
| MONGE. Application de l'Analyse à la Géométrie.                  |                                                                                                    |

## II.—ANALYTICAL AND CELESTIAL MECHANICS.

*Regular course.*

- LAPLACE.** *Mécanique Céleste*, translated, with a Commentary, by Dr. Bowditch. Vol. I.  
**BOWDITCH.** On the Computation of the Orbits of a Planet or Comet: Appendix to Vol. III of his translation.  
**AIRY.** Figure of the Earth, from the *Encyclopædia Metropolitana*.  
**AIRY.** Tides, from the *Encyclopædia Metropolitana*.

*Parallel course.*

- POISSON.** *Mécanique Analytique*.  
**LAGRANGE.** *Mécanique Analytique*.  
**HAMILTON.** General Method in Dynamics, from the London Philosophical Transactions for 1834 and 1835.  
**GAUSS.** *Theoria Motus Corporum Cœlestium*.  
**BESSEL.** *Untersuchungen*.  
**LEVERRIER.** *Développements sur Plusieurs Points de la Théorie des Perturbations des Planètes*.  
**LEVERRIER.** *Les Variations Séculaires des Eléments des Orbites, pour les Sept Planètes Principales*.  
**LEVERRIER.** *Théorie des Mouvements de Mercure*.  
**LEVERRIER.** *Recherches sur les Mouvements de la Planète Herschel*.  
**ADAMS.** Explanation of the Observed Irregularities in the Motion of Uranus, on the Hypothesis of Disturbances caused by a more distant Planet.

## III.—MECHANICAL THEORY OF LIGHT.

*Regular course.*

- AIRY.** *Mathematical Essays*.  
**MACCULLAGH.** On the Laws of Crystal-Line Reflection and Refraction. (Transactions of the Royal Irish Academy, Vol. XVIII.)

*Parallel course.*

- CAUCHY.** *Exercices d'Analyse et de Physique Mathématiques*.  
**NEUMANN.** *Theoretische Untersuchung der Gesetze, nach welchen das Licht reflectirt und gebrochen wird.* (Transactions of Berlin Academy for 1831.)

Such a course of studies had never before been open to American students in any American college. Such a course, or any other equally advanced, was never presented in any other American institution before the arrival at the Johns Hopkins University of Professor Sylvester. It must be admitted that the great mass of Harvard students never studied more mathematics than was absolutely required for their degree, but now and then Peirce had a pupil who liked mathematics, understood the greatness of his teaching, and appreciated and loved his character. Peirce was the center of an influence which led to the starting of many a sincere distinguished scientific career. Prof. T. H. Safford, one of his favorite pupils, says: "Among distinguished scholars of the years which I remember, were Prof. G. P. Bond, afterward of the Observatory; Dr. E. A. Gould, celebrated as an astronomer; Rev. Thomas Hill, for a while president of Harvard; Prof. J. D. Runkle, of the Institute of Technology, Boston; Prof. J. E. Oliver, of Cornell Univer-

sity; Prof. A. Hall and Prof. S. Newcomb, of the U. S. Navy; Mr. W. P. G. Bartlett, since deceased; Mr. G. W. Hill, of the Nautical Almanac Office; Mr. Chauncey Wright, known as a philosopher; Prof. James M. Peirce and President Eliot, of Harvard; Prof. O. M. Woodward, of St. Louis; Rev. G. W. Searle, of St. Paul's (R. O.) Church, New York City; Prof. W. Watson, formerly of the Institute of Technology; Professor Byerly, now at Harvard."\*

Of Peirce as a teacher, Dr. A. P. Peabody gives us an interesting account.† It refers to the first year that Peirce was professor at Harvard.

"For the academic year 1832-33, I, as tutor, divided the mathematical instruction with Mr. Peirce. \* \* \* He took to himself the instruction of the Freshmen. The instruction of the other three classes we shared, each of us taking two of the four sections into which the class was divided, and interchanging our sections every fortnight. \* \* \* In one respect I was Mr. Peirce's superior, solely because I was so very far his inferior. I am certain I was the better instructor of the two. The course in the Sophomore and Junior years, embracing a treatise on the Differential Calculus, with references to the calculus in the text-books on mechanics and other branches of mixed mathematics, was hardly within the unaided grasp of some of our best scholars; and, though no student dared to go to the tutor's room by daylight, it was no uncommon thing for one to come furtively in the evening to ask his teacher's aid in some difficult problem or demonstration. For this purpose resort was had to me more frequently than to my colleague, and often by students who for the fortnight belonged to one of his sections. The reason was obvious. No one was more cordially ready than he to give such help as he could; but his intuition of the whole ground was so keen and comprehensive that he could not take cognizance of the slow and tentative processes of mind by which an ordinary learner was compelled to make his step-by-step progress. In his explanations he would take giant strides; and his frequent, 'you see,' indicated what he saw clearly, but that of which his pupils could get hardly a glimpse. \* \* \*

"Our year's work was on the whole satisfactory, and yet I think that we were both convinced that the differential calculus ought not to have been a part of a prescribed course. There was a great deal of faltering and floundering, even among else good scholars. \* \* \* Our examinations were *visa voce*, in the presence of a committee of reputed experts in each several department. We shrank from the verdict of our special committee in no part of our work except the calculus. As the day approached for the examination in that branch we were solicitous that Robert Treat Paine, who was on the committee, should not be present; for we supposed him to be the only member of the committee who was conversant with the calculus. He did not come, and we were

\*Letter to the writer, November 6, 1888.

†Harvard Reminiscences, 1888, p. 182.

glad. • • • If there were defects and shortcomings, there was certainly no one present who could detect them."

Peirce had no success in teaching mathematics to students not mathematically inclined. Repeated and loud complaints were made at Harvard that the mathematical teaching was poor. The majority of students disliked the study and dropped it as soon as possible. Says Prof. William F. Allen (class of 1851) in a letter to the writer:

"I am no mathematician, but that I am so little of one is due to the wretched instruction at Harvard. Professor Peirce was admirable for students with mathematical minds, but had no capacity with others. He took only elective classes, and of course I didn't elect. Only two did in our class of about sixty, and I believe they soon dropped it. In my Freshman year I had very good instruction from Mr. Child, now the professor of English literature, and editor of ballads. I had algebra and geometry with him, and did fairly well. In the Sophomore year (trigonometry and analytic geometry) we had a different instructor, and it was a mere farce. In analytic geometry I was taken up once in the course of the term, on rectangular co-ordinates in space, and I knew perfectly well (although I was never so told) that at examination I should be called up upon rectangular co-ordinates in space. (Written examinations had never been heard of.) When examination day came (a committee in attendance) the tutor was sick, and a shudder ran through the class. But he heroically pulled himself together and held his examination in person, and I was examined upon rectangular co-ordinates in space. The sum of my knowledge of analytical geometry at the present day is that there are such things (or were) as rectangular co-ordinates in space—and I suppose there must also be some out of space. • • • Peirce's text-books were used. His geometry I liked much, also the algebra, only that it was pretty hard. • • •

"I graduated in 1851, and I remember when I was in Germany two or three years later, I met a gentleman who had just returned from America—a young German *Gelahrte*—and he assured me that there was not one mathematician in the United States, and only one astronomer, Peirce. It was not an agreeable thing to be told, for a patriotic young American as I was then, but I suppose it was not far from the truth."

In January, 1848, Thomas Sherwin, by order of the committee for examination in mathematics reported that in 1847 there were present for examination but one Senior in Bowditch's Laplace, and only five Juniors in Curves and Functions. He went on to say that mathematics could be made attractive, that, hence, arose the inquiry, why this study was so very decidedly unpopular at the University, and why so general an opinion prevailed throughout the community, that the student stood less creditable in this branch than in others. The answer to this was that the text books were abstract and difficult, that few could comprehend them without much explanation, that Peirce's works were symmetrical and elegant, and could be perused with pleas-

ure by the adult mind, but that books for young students should be more simple. The report then says that there are mathematical works of no small merit, which embraced the same subjects as the text-books now used, which were much less difficult of comprehension, such as Bourdon's Algebra, J. R. Young's Treatises, and a recent edition of Hutton's Mathematics.

The majority report was followed by a minority report by Thomas Hill and J. Gill, which differed regarding the text-books at Harvard. "Your minority of the committee believe that these text-books, by their beauty and compactness of symbols, by their terseness and simplicity of style, by their vigor and originality of thought, and by their happy selection of lines of investigation, offer to the student a beautiful model of mathematical reasoning, and lead him by the most direct route to the higher regions of the calculus. For those students who intend to go farther than the every-day applications of trigonometry, this series of books is, in the judgment of the minority, by far the best series now in use."

While the good qualities of Peirce's text-books, as described by the minority, must be acknowledged, it is nevertheless true, that owing to their compactness and brevity, which characterize all the writings of Peirce, the books seemed obscure to beginners.\* Still, however, they continued to be used at Harvard for many years longer.

Professor Peirce said in his report of November 6, 1849, on the teaching of higher mathematics in the college and the Lawrence Scientific School, that he had two pupils. One of these students was a member of the Lawrence Scientific School, and the other was the child, T. Henry Safford, who had attracted so much attention for his early development of mathematical ability. "These two students attended lectures on analytical mechanics, and young Safford showed himself perfectly competent to master the difficult subject of research, and once or twice surprised his teacher by the readiness with which he anticipated the object of some peculiar form of transformation. Up to this time Safford fully realizes his early promise of extraordinary powers as a geometer, but his friends cannot free themselves from apprehension, when they perceive that the growth of his body does not correspond to that of his intellect." He then states that with the mathematical pupil of the school the professor read also Lagrange's *Mécanique Analytique* and Laplace's *Théorie Analytique des Probabilités*.

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\*In another place, Rev. Thomas Hill speaks of these books as follows (memorial collection by Moses King): "His text-books were also complained of for their condensation, as being therefore obscure; but under competent teachers, the brevity was the cause of their superior lucidity. In the Waltham High School his books were used for many years, and the graduates attained thereby a clear and more useful, applicable knowledge of mathematics than was given at any other high school in this country; nor did they find any difficulty in mastering even the demonstration of Arbogast's Polynomial Theorem, as presented by Peirce. The latter half of the volume on the integral calculus, full of the marks of a great analytical genius, is the only part of all his text-books really too difficult for students of average ability."

As regards the number of students electing mathematics, the committee of overseers stated, in 1849, that as long as the choice is offered, the lighter labor will always be preferred, and that this tendency will probably get stronger. "Hebrew roots and polynomial roots will be neglected in a garden abounding with French bouquets and Italian music; and even now it can not surprise us that, while the Smith professor of French and Spanish language and literature, and instructor in Italian, is surrounded by a gay crowd of utilitarian admirers, the Perkins professor of mathematics and astronomy is working in his deep mines for one infant prodigy and one eminent Senior." Some Juniors studied analytical statics, and gave the best evidence of successful devotion to the subject.

The elective system was abandoned almost completely in 1850. Mathematical studies were elective only in the Junior and Senior years. In 1867 the elective system was again adopted at Harvard, and on the most liberal scale. Sophomore mathematics were again no longer "required." Peirce's books still held their ground. The only invaders were J. M. Peirce's *Analytical Geometry*, and, in 1865, Puckle's *Analytic Geometry*. In 1869 the committee of overseers reported that mathematics was a required study only for the Freshmen; that elective mathematics were taken this year by one hundred Sophomores, six Juniors, and eight Seniors; that the Sophomores and Juniors could elect either pure or applied. They also stated that "the number electing this department in the upper classes is never expected to be large, as the studies are advanced beyond what most students have either aptitude or occasion for."

We find that, "for the last few years of his life Professor Peirce had for his pupils only young men who were prepared for profounder study than ever entered into a required course, or a regularly planned curriculum; but he never before taught so efficiently, or with results so worthy of the mind and heart and soul, which he always put into his work."\*

It will be instructive to listen to what former pupils of Peirce have to say of him. Prof. Truman Henry Safford, of Williams College, says in a letter to the writer: "I was a student at Harvard in the class of 1854. Prof. B. Peirce taught the Sophomores, I believe (I entered the Junior class, but not very well; he had hardly patience enough, I suppose. To the Juniors and Seniors he lectured on higher algebra, the calculus, and analytical mechanics. His lectures were substantially contained in his text books—*Algebra*, *Curves and Functions*, and *Analytic Mechanics*. They were very interesting and inspiring to those who could follow them. There was but little practice; the examples in the book were generally worked out. In my class a number (twelve or so) took the first year's work; the second, which included integral elements, complex numbers, and analytical mechanics, was taken by

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\* *Harvard Reminiscences*, by A. P. Peabody, p. 186.

four only. One of them was O. K. Lowell, afterwards a cavalry general in the Civil War, a nephew of Professor Lowell; another, George Putnam, Esq.; a third, W. C. Paine, afterwards a West Point scholar, where he was first in his class, and a lieutenant of engineers, but he resigned as a captain. The fourth was myself. I had heard some of Professor Peirce's lectures some years before, while a school-boy, but could not follow them so well."

For some years following 1838 Prof. Joseph Lovering taught classes in mathematics. Of him and Peirce, Edward E. Hale says: "The classical men made us hate Latin and Greek; but the mathematical men (such men! Peirce and Lovering) made us love mathematics, and we shall always be grateful to them."

Says Thomas Wentworth Higginson: "As to mathematical instruction, this reform (elective system) was an especial benefit, for Professor Peirce's genius revelled in the new sensation of having voluntary pupils, and he gave a few of us his *Curves and Functions* as lectures, with running elucidations. Nothing could be more stimulating than to see our ardent instructor, suddenly seized with a new thought and forgetting our very existence, work away rapidly with the chalk upon a wholly new series of equations; and then, when he had forced himself into the utmost corner of the blackboard and could get no farther, to see him come back to earth with a sigh and proceed with his lecture. We did not know whither he was going, but that huddle of new equations seemed like a sudden outlet from this world, and a ladder to the stars. He gave a charm to the study of mathematics which for me has never waned, although the other pursuits of life soon drew me from that early love. This I have always regretted, and so did Peirce, who fancied that I had some faculty that way, and had me put, when but eighteen, on a committee to examine the mathematical classes of the college. Long after, when I was indicted for the attempted rescue of a fugitive slave, and the prison walls seemed impending, I met him in the street and told him that if I were imprisoned I should have time to read Laplace's *Mécanique Céleste*. 'In that case,' said the professor, who abhorred the abolitionists, 'I sincerely wish you may be.'"

Among the more prominent mathematical tutors of this period may be mentioned C. W. Eliot, now president of Harvard, and James Mills Peirce, a son of Benjamin Peirce. The latter graduated in 1853, was tutor from 1854 to 1858, and from 1860 to 1861, when he was made assistant professor of mathematics. In 1867 he became university professor of mathematics.

Benjamin Peirce presided for some years over a mathematical society. It comprised eight or ten men of some reputation in Boston and Cambridge, who met to discuss mathematical topics. Each member would present to the society such novelties as his inquiries into some particular branch had suggested, and "in the discussion which followed, it

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\* How I was Educated, *Forum*, I, April, 1886, p. 61.



would almost invariably appear that Peirce had, while the paper was being read, pushed out the author's methods to far wider results than the author had dreamed.\* His mind moved with great rapidity, and it was with great difficulty that he brought himself to writing out even the briefest record of its excursions.<sup>7</sup>

We now proceed to a brief account of Benjamin Peirce's original researches. Several original articles were contributed by him to the *Mathematical Miscellany* and to the *Cambridge Miscellany*. Peirce had planned an extended treatise on *Physical and Celestial Mechanics*, to be developed in four systems, of *Analytical Mechanics*, *Celestial Mechanics*, *Potential Physics*, and *Analytic Morphology*. Of these four, only one appeared, the system of *Analytic Mechanics*, in 1855. The substance of this was prepared as a part of a course of lectures for mathematical students at Harvard. The publication was undertaken at the request of some of his pupils, especially of J. D. Runkle. He consolidated the latest researches into a consistent and uniform treatise, and carried "back the fundamental principles of the science to a more profound and central origin." It was very far from being a mere compilation. In his books he supplanted many a traditional method in mathematics by concise and axiomatic definitions and demonstrations of his own invention. As an instance of this we mention his assumption as self-evident that a line which is wholly contained upon a limited surface, but which has neither beginning nor end on that surface, must be a curve re-entering upon itself. By this new axiom he reduces a demonstration which would otherwise occupy half a dozen pages to a few lines.<sup>8</sup>

Peirce's *Analytical Mechanics* was generally acknowledged at the time, even in Germany, to be the best of its kind.<sup>9</sup> An American student in Germany asked once an eminent German professor what book he would recommend on analytical mechanics. The reply was instantaneous, "There is nothing fresher and nothing more valuable than your own Peirce's recent quarto."

Benjamin Peirce was much interested in the comet of 1843, and in a few lectures he aroused by his great eloquence an interest in astronomy which led to the foundation of the observatory of Cambridge. His mathematical ability was first brought into general notice in connection with the discovery of Neptune. Messrs. Adams, of Cambridge, and Leverrier, of Paris, had calculated, from theory alone, where this planet ought to appear in the heavens, if visible, and Galle, of Berlin, discovered on September 23, 1846, the planet at the place indicated to him by Leverrier. Peirce began to study the planet's motion, and came to the conclusion that its discovery was a happy accident; not that Leverrier's calculations had not been exact, and wonderfully laborious.

\* *Nature*, October 14, 1880.

<sup>7</sup> Rev. Thomas H. Morgan, *Memorial Collection*, by Moses King.

<sup>8</sup> *Nature*, October 27, 1880.

and deserving of the highest honor, but because there were, in fact, two very different solutions of the perturbations of Uranus possible; Leverrier had correctly calculated one, but the actual planet in the sky represented the other, and the actual planet and Leverrier's ideal one lay in the same direction from the earth only in 1846.

Astronomers of to-day would hardly accept Peirce's conclusions. "His views came, probably, from a misapprehension of Leverrier's methods. There are two methods by which, in theory, the problem could be approached, that of *general* and that of *special* perturbations. Leverrier used the latter, while Peirce's criticisms seem directed against the former."\*

On February 2, 1847, Mr. C. Walker, of Washington, discovered that a star observed by Lalande in May, 1795, must have been the planet Neptune. This observation afforded the means of an accurate determination of the orbit. Walker's orbit of Neptune furnished Peirce with materials for still more thorough investigation of the theory and re-determination of the perturbations. These perturbations enabled Walker to get an orbit more correct, which Peirce used again in his turn. Thus, eighteen months after the discovery of Neptune its orbit was calculated by American astronomers so accurately that the conformity between the predicted and observed places was far more close for Neptune than any other planet in the heavens.†

A few years later Peirce published his investigations on Saturn's rings. The younger Boud had seen the ring divide itself and re-unite, and had been led by this to deny the solidity of their structure. Peirce followed with a demonstration, on abstract grounds, of their non-solidity.‡ The same subject was afterward investigated again in England by James Clerk Maxwell.

Admiral C. H. Davis, a relative of Peirce, succeeded in persuading Congress to pay for the calculation of an American almanac for the sailors, so that we would not be dependent upon foreigners, which might be troublesome in case of war. The Nautical Almanac Office was established at first in Cambridge, under Davis's business management and Peirce's scientific control.§ One of the assistants in the office, appointed in 1849, was J. D. Runkle, then one of Peirce's pupils in the Lawrence Scientific School. He helped in the preparation of the American Ephemeris and Nautical Almanac, in which he continued to engage till 1884.

The publications of this office gained scientific recognition from the first. In 1852 were printed Peirce's Lunar Tables, to be used in making

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\* Prof. G. C. Comstock, Washburn Observatory, in a letter to the writer. Prof. C. A. Young claims that the discovery was not an accident (*General Astronomy*, p. 371).

† Proceedings American Association for Advancement of Science, Vol. VIII, 1854, address by B. A. Gould, jr., p. 12.

‡ *Astronomical Journal* (Gould's), Vol. II, p. 5.

§ Development of Astronomy in the United States, by T. H. Safford, 1888, p. 21.

computations for the Nautical Almanac. They were intended to serve only a temporary purpose until Hansen's long expected tables should make their appearance, but they continued to be used after that. He made very laborious and exact calculations of the occultations of the Pleiades, which furnished means of studying the form both of the earth and the moon.

From 1852 to 1867 Peirce had the direction of the longitude observations for the U. S. Coast Survey, and in 1867, after the death of Bachs, he was appointed Superintendent of the U. S. Coast Survey, which office he held till 1874.

Benjamin Peirce was more celebrated, in his day, as a mathematical astronomer than as a cultivator of pure mathematics. His most important researches in pure mathematics were not placed in reach of the mathematical public until after his death. In our opinion, Peirce will be remembered by future generations for his investigations on Linear Associative Algebra, quite as well as for his other scientific achievements. He will be remembered as an algebraist as well as an astronomer. His thoughts were turned especially toward the logic of mathematics and the limits and extension of fundamental processes. He read several papers on algebra before the American Academy for the Advancement of Science. In 1870 one hundred lithographed copies of a memoir on Linear Associative Algebra, read before the National Academy of Sciences, were taken, for distribution among his friends. This memoir was at last published in the American Journal of Mathematics, Vol. IV, No. 2, with notes and addenda by C. S. Peirce, son of the author. Benjamin Peirce himself considered this memoir the best of his scientific efforts. The lithographed copies contain the following modest introductory remarks by the author, which are omitted in the American Journal of Mathematics:

"TO MY FRIENDS:"

"This work has been the pleasantest mathematical effort of my life. In no other have I seemed to myself to have received so full a reward for my mental labor in the novelty and breadth of the results. I presume that to the uninitiated the formulas will appear cold and cheerless, but let it be remembered that, like other mathematical formulae, they find their origin in the divine source of all geometry. Whether I shall have the satisfaction of taking part in their exposition, or whether that will remain for some more profound expositor, will be seen in the future."<sup>\*</sup>

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\* Peirce distinguishes his algebras from each other by the number of their fundamental conceptions, or of the letters of their alphabet. Thus, an algebra which has only one letter in the alphabet is a *single algebra*; one that has two a *double algebra*, and so on. His investigation does not usually extend beyond the sextuple algebra. This class he calls *field* and *constructive*, like the artificial Linnæan system of botany. "But it is not from a preliminary investigation of algebras until a sufficient variety is obtained to afford the material for a natural classification." He then begins his researches with *single algebra*, then goes to *double algebra*, and so on.

Peirce's memoir is a wonderful volume. It is almost entitled to rank "as a *Principia* of the philosophical study of the laws of algebraical operation."

One of the pall-bearers at the funeral of the greatest American algebraist was Prof. J. J. Sylvester.

During the last ten years of his life Benjamin Peirce was relieved of much of the labor and responsibility falling upon the head of a department in a university by his son, Prof. James Mills Peirce. Though not the heir of his father's genius, Prof. J. M. Peirce is a thorough and able mathematician. He excels his father in being an excellent teacher. In 1857 he published an *Analytic Geometry*, which was used for some years as a text-book at Harvard. He has also published *Three and Four Place Tables of Logarithmic and Trigonometric Functions*, 1871; *Elements of Logarithms*, 1873, and *Mathematical Tables*, chiefly to Four Figures, 1st Series, 1879.

Connected with the mathematical department are, since 1870, Prof. C. J. White; since 1876, Prof. W. E. Byerly; since 1881, Prof. Benjamin O. Peirce, and Mr. George W. Sawin.

Professor Byerly published in 1890 his *Elements of the Differential Calculus*, and in 1882 his *Elements of the Integral Calculus*. Byerly's *Calculus* is a scholarly work. In the rigorous treatment and judicious selection of subjects and adaptability to class use it is, we believe, surpassed by no other American work. Professor Byerly uses the notation,  $D_x y$ , which was first employed in this country by Benjamin Peirce. In answer to a letter of inquiry regarding the history of this notation Professor Byerly says:\* "It was certainly used with some

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up to sextuple, making nearly a hundred algebras, which he shows to be possible. Of all these, only three algebras had ever been heard of before. Of the two single algebras we have one—the common algebra, including arithmetic. Of the three double algebras we have one, the calculus of Leibnitz and Newton. Of over twenty quadruple algebras we have the quaternions of Hamilton.

Prof. Arthur Cayley, in his presidential address before the British Association, in 1883, speaking of Peirce's *Linear Associative Algebra*, said: "We here consider symbols  $A, B$ , etc., which are linear functions of a determinate number of letters or units,  $i, j, k, l$ , etc., with co-efficients which are ordinary analytical magnitudes, real or imaginary (viz, the co-efficients are in general of the form  $x + iy$ , where  $i$  is the before-mentioned imaginary, or  $\sqrt{-1}$ ). The letters  $i, j$ , etc., are such that every binary combination  $ij, ji$ , etc., (the  $ij$  being in general not equal to  $ji$ ) is equal to a linear function of the letters, but under the restriction of satisfying the associative law, viz, for each combination of three letters  $ijk = ijk$ , so that there is a determinate and unique product of three or more letters; or, what is the same thing, the laws of combination of the units  $i, j, k$ , are defined by a multiplication table giving the values of  $ij, ji, jk$ , etc.; the original units may be replaced by linear functions of these units, so as to give rise, for the units finally adopted, to a multiplication table of the most simple form; and it is very remarkable how frequently in these simplified forms we have nilpotent or idempotent symbols ( $i^2=0$ , or  $i^2=i$ , as the case may be), and symbols  $i, j$ , such that  $ij=ji=0$ ; and, consequently, how simple are the forms of the multiplication tables which define the several systems, respectively."

\* Letter to the writer, December 27, 1883.

freedom in England and on the Continent in the first half of this century. It is given in Barlow's *Mathematical Dictionary*, 1814, was used by Cauchy about 1830, by Tortolini in 1844, by Schlömilch in 1846, and by Boole and Carmichael somewhat later, and each of the authors I have mentioned uses the symbol as if it were a familiar one and without reference to its history."

Prof. Benjamin Osgood Peirce has published *Elements of the Theory of the Newtonian Potential Function*, 1886.

Since 1867 great changes have been made in the requirements for admission to Harvard and in the arrangement of the mathematical courses. Since that time the elective system has been in operation in full force. The terms for admission have been much increased.

From the selected sheets of the Harvard University Catalogue for 1888-89 we take the following regarding the requirements for admission, omitting whatever has no bearing on mathematics:

The examinations for admission embrace two classes of studies, *elementary and advanced*.

The elementary studies are not supposed to be equivalent to one another; Greek, Latin, and mathematics have much greater weight in the examinations than any of the rest.

The advanced studies are supposed to be equivalent in regard to time spent upon them at school, and will have the same weight in the examinations. Each of the advanced studies is taught in college in an elective course (or two half-courses) occupying three hours a week for a year; and the standard required at the entrance examinations is the same as in the corresponding college courses.

The elementary studies are prescribed for all candidates, except under the conditions named below (Paragraph 1); and every candidate is further required to present himself for examination in not less than two of the advanced studies.

1. The advanced study numbered 16 together with one of the three numbered 7 (see below under "advanced studies in mathematics"), 8 (physics), and 9 (chemistry), may be substituted for either elementary Greek or elementary Latin.

*Elementary Studies in Mathematics*—

a. Algebra, through quadratic equations. (The requirement in algebra embraces the following subjects: Factors, common divisors and multiples, fractions, ratios, and proportions; negative quantities and the interpretation of negative results; the doctrine of exponents; radicals and equations involving radicals; the binomial theorem for positive integral exponents and the extraction of roots; putting quadratic equations, and the reduction of equations; the ordinary methods of elimination; and the solution of both numerical and literal equations of the first and second degrees, with one or more unknown quantities, and of problems leading to such equations.) b. Plane geometry.

*Advanced Studies in Mathematics*—

6. Mathematics. a. Logarithms; plane trigonometry, with its applications to surveying and navigation. b. Either solid geometry or the elements of analytic geometry.

7. Mathematics. c. Either the elements of analytic geometry or solid geometry (b). d. Either celestial mechanics or advanced algebra.

The following books are recommended to indicate the nature and amount of the requirements in mathematics, viz., *Trigonometry*, *Analytic Geometry*, and *Mechanics*.

For *Trigonometry*, see *Wheeler's Logarithms* (Cambridge, Sever) or the unabridged edition of Peirce's *Elements of Logarithms* (Boston, Ginn & Co.).

Wheeler's Plane Trigonometry (same publishers). Problems in Plane Trigonometry (Cambridge, Sever). Peirce's Mathematical Tables (Boston, Ginn & Co.).

Analytic Geometry. Briggs's Analytic Geometry (New York, Wiley & Co.).

Mechanics. Goodwin's Elementary Statics (London, Bell & Sons; Cambridge, Sever).

Advanced Algebra. Wentworth's College Algebra (Boston, Ginn & Co.), to article 498, omitting Chapters XIX, XX, XXIV, XXV, XXVII, XXVIII. The examination will be mainly occupied with the portions of algebra, as thus defined, which are not included in the elementary requirement in algebra; but elementary questions are not necessarily excluded.

All in all, there are nine "advanced" studies to choose from. Since one can enter the college after passing an examination on all the "elementary" studies, and on at least two of the "advanced" studies, it follows that the least amount of mathematics required for admission, as a regular student, is that stated above under the heading "Elementary Studies in Mathematics."

The following are the

*Courses of instruction in mathematics.*

(1888-89.)

A. Logarithms.—Plane Trigonometry, with its applications to Surveying and Navigation. *Half-course. Tu., Th., Sat., at 11 (first half-year). Professor C. J. WHITE.*

B. Analytic Geometry (elementary course). *Half-course. Tu., Th., Sat., at 11 (second half-year). Professor C. J. WHITE.*

C. Analytic Geometry (extended course). *Mon., Wed., Fri., at 2. Professor BYERLY.*

D. Algebra. *Half-course. Mon., Wed., Fri., at 11 and 3 (first half-year). Mr. SAWIN.*

G. Algebra (extended course). *Half-course. Tu., Th., Sat., at 10 (first half-year). Mr. SAWIN.*

E. Solid Geometry. *Half-course. Tu., Th., Sat., at 10 (second half-year). Mr. SAWIN.*

F. Elementary Mechanics. *Half-course. Mon., Wed., Fri., at 12 (second half-year). Mr. SAWIN.*

Not to be given after 1888-89.

Courses A, B, E, and F correspond to Advanced Mathematical Studies embraced, as optional studies, in the examination for admission to college.

1. Practical Applications of Plane Trigonometry.—Spherical Trigonometry.—Applications of Spherical Trigonometry to Astronomy and Navigation. *Wed., Fri., at 3. Professor C. J. WHITE.*

Course 1 is open to Freshmen who have passed the examination in Plane Trigonometry.

2. Differential and Integral Calculus (First Course). *Mon., Wed., Fri., at 11. Professor C. J. WHITE.*

Course 2 is open to those only who have taken Course B or Course C.

3. Analytic Geometry; higher course. *Mon., Wed., Fri., at 10. Professor J. M. PEIRCE.*

Course 3 is intended for students who have taken Course C; but those who have taken Course B may elect it, if deemed qualified by the instructor.

4. The Elements of Mechanics. *Tu., Th., Sat., at 9. Professor B. O. PEIRCE.*

Course 4 is intended for students who take or have taken Course 2.

Candidates for Second-Year Honors may take Courses 2 and 3, or 2 and 4.

Other courses may be accepted on special petition.

5. Differential and Integral Calculus (Second Course). *Mon., Wed., Fri., at 11. Professor BYERLY.*

- [6. Quaternions and Theoretical Mechanics. *Mon., Wed., Fri., at 12.* Professor J. M. PEIRCE.]  
 Omitted in 1884-85.
- [7. Higher Plane Curves. Professor J. M. PEIRCE.]  
 Omitted in 1884-85.
8. Analytic Mechanics. *Mon., Wed., Fri., at 10.* Professor BYERLY.
9. Quaternions and Theoretical Mechanics (Second Course). *Mon. at 12, Fri. 11-1.*  
 Professor J. M. PEIRCE.
10. Trigonometric Series: Introduction to Spherical Harmonics.—Theory of the Potential. *Tue., Fri., at 12, Wed. at 10.* Professors BYERLY and B. O. PEIRCE.
- [11. Hydromechanics. Professor B. O. PEIRCE.]  
 Omitted in 1884-85.
13. The Theory of Functions. *Mon. at 11, Wed. 11-1.* Professor J. M. PEIRCE.
20. Special Advanced Study and Research.—The work of the following courses will consist in investigations and reading, to be carried on by the students in the courses, under the guidance of the instructors. Students will be expected to present their results from week to week in the form of lectures and theses.
- (a) Questions in the Theory of Functions. *Wed., 3.30-5.30.* Professor J. M. PEIRCE.
- (b) Higher Algebra (First Course). Mr. SAWIN.

Some few studies in the college course are prescribed, but *all mathematical studies are elective*. No mathematics need therefore be studied in college. A student can, if he chooses, get the degree of bachelor of arts without having had more mathematics than plane geometry and algebra through quadratic equations—the minimum requirement for admission.

We conclude this article by quotations from a letter by Prof. L. M. Hoskins, of the University of Wisconsin, who, in the year 1884-85, was honored with a fellowship at Harvard, and studied higher mathematics there.

"There were two courses, in 'quaternions and theoretical mechanics,' given by Prof. J. M. Peirce, each three lectures weekly for the year. The first course gave the elements of quaternions and the dynamics of a particle, covering about the ground of Tait and Steele's dynamics of a particle, but treated by quaternion methods largely. The second course continued with higher applications. • • • A third course, on analytic mechanics, was offered by Prof. J. M. Peirce, consisting of lectures, following Benjamin Peirce's *Analytic Mechanics*, for the first half-year, and for the second Routh's *Rigid Dynamics*, the part relating to moving axes and relative motion, oscillations about equilibrium, oscillations about a given state of motion, motion of a rigid body under any forces—in short, the first five chapters of Volume II. • • • I attended also a course in 'arbitrary functions,' by Prof. W. E. Byerly. This covered most of the ground of Riemann's *Partielle Differentialgleichungen*, &c. The main subject treated is the methods of solution of partial differential equations subject to given conditions, a class of problems constantly arising in physics. The course naturally includes the proof and discussion of Fourier's Theorem, and the treatment of the different kinds of spherical harmonics, since these are of great use in the

solution of certain classes of partial differential equations. On the whole, I found this as attractive a part of pure mathematics as I ever entered. • • •

"I may remark that the branches of higher mathematics to which most attention is paid at Harvard seem to be theoretical mechanics and quaternions. This is doubtless due to the influence of Benjamin Peirce, whose attainments in the former line are well known, and who was also among the first to recognize the high value of quaternion methods. • • • I am able to give both of them (Professors J. M. Peirce and Byerly) high praise as teachers of mathematics. Both are clear, logical lecturers, and popular with the students. • • • Of him [Prof. B. O. Peirce] I have little personal knowledge, but am sure no professor was held in higher estimation, both as to attainments and ability as a teacher. • • • In 1884-85 the number of graduate students taking mathematics was five. • • •

"A mathematical 'seminar' was maintained with a good deal of interest, with weekly meetings throughout the greater part of the year. These meetings were under the supervision of the mathematical faculty, and were rather informal in nature, though a formal programme was usually carried out, usually by volunteer lectures or solutions."

#### YALE COLLEGE.

The successor in the chair of mathematics and natural philosophy to the lamented Professor Fisher was Matthew R. Dutton. He was a graduate of the college and was professor from 1822 to 1825. He was the author of a work on conic sections and spherical trigonometry. This work was subsequently revised by Dwight, who "laid the students and teachers of that day under everlasting obligations by his simplification and abbreviation of those endless algebraic formulæ in Dutton's Conic Sections."

From 1825 to 1836 Denison Olmsted occupied the chair which had been made vacant by the death of Professor Dutton. He was born in Hartford, Conn., in 1791, graduated at Yale in 1813, became tutor there in 1815, was elected professor of chemistry at the University of North Carolina in 1815, and finally returned thence to assume the duties of the chair of mathematics and physics at Yale. He had made natural philosophy and chemistry his specialty, and possessed no special fitness for the teaching of mathematics.

Professor Olmsted was renowned as a teacher rather than an original investigator. His teaching power was indeed great, and he exerted a beneficial influence, not only in college, but also upon the education in the common schools of Connecticut. In 1831 appeared his *Natural Philosophy*, which superseded the antiquated work of Enfield. In the next year was written his *School Philosophy*, a more elementary work; and in 1839 his *Astronomy*. He wrote also the *Rudiments of Natural Philosophy and Astronomy*, which passed through some fifty editions.



His Natural Philosophy and Astronomy came to be almost universally used in our colleges. The Philosophy was later revised by Prof. E. S. Snell, of Amherst College, and, still later, by Prof. J. Ficklin, of the University of Missouri. In point of scientific accuracy Olmsted's works were sometimes rather defective. They were somewhat old-fashioned.

As early as 1830 a good telescope of moderate size was procured at Yale College. For want of an observatory it was difficult to make accurate observations with it. But it served, nevertheless, the excellent purpose of furnishing a means of observing the great November shower of meteors, which occurred not long afterward. These showers, Halley's Comet, and the telescope enabled Professor Olmsted to arouse a great deal of astronomical enthusiasm at Yale, and for a few years a number of students turned their attention to astronomy. Of the mathematicians and astronomers who graduated in those days are Stanley and Mason, long since deceased; and Loomis and Lyman, who are now aged professors at Yale. The ablest mathematician and astronomer which Yale has produced is William Chauvenet. As a teacher he was never connected with his *alma mater*, though a professorship was offered him twice.

In 1835 the chair of mathematics and natural philosophy was divided into two separate ones—Olmsted retaining that of natural philosophy, and Anthony D. Stanley being elected to that of mathematics.

One of the most prominent of early tutors in mathematics at Yale was F. A. P. Barnard, of the class of 1828, which was known as a "mathematical class," for the mathematical talent it embraced. While tutor at Yale he prepared an edition of Bridge's Conic Sections, in which the work was substantially rewritten and also considerably enlarged.

We proceed to examine the mathematical courses during the time of Professors Dutton and Olmsted.

In 1824, Arithmetic was the requirement in mathematics for admission; in 1833, "Barnard's or Adam's Arithmetic;" in 1845, Arithmetic and Day's Algebra to quadratics.

The mathematical course for 1824 was, for Freshmen, Day's Algebra during the first two terms, with no mathematics for the third term; for Sophomores, six books of Playfair's Euclid during the first and part of the second term, and Day's Mathematics (including plane trigonometry, logarithms, mensuration of surfaces and solids, isoperimetry, navigation and surveying) and Dutton's Conic Sections, during the rest of the year; for Juniors, Dutton's Spherical Trigonometry during the first term, and Enfield's Astronomy and Vince's Fluxions during the third term. The Seniors had no mathematics in their course. In 1825 the study of Euclid was begun at the close of the Freshman year. Vince's Fluxions still appeared in that year as a text book.

The writer has not been able to see catalogues for the years 1826-32. In 1833, Olmsted's Natural Philosophy was in use. "Fluxions" were also named, but this meant then, most likely, the differential and in-

tegral calculus. In the Sophomore year, Bridge's Conic Sections (probably Barnard's edition) was used in place of Dutton's. No changes in the course were made for several years after.

The teaching of mathematics to the two lower classes in college was generally intrusted to young and inexperienced tutors, who had, as a rule, a very meagre acquaintance with the subjects which they were supposed to teach. It is therefore not surprising that poor results were generally reached, and that the study of mathematics was very unpopular. Especially unpopular was the study of conic sections. No efforts seem to have been made on the part of tutors to make this study more attractive and to show its usefulness, by pointing out its application in the study of physics and astronomy. Moreover, the old books on conic sections were as dry as dust. The dissatisfaction among students finally culminated, in 1830, in what is known as the "conic sections rebellion." Rebellions among students were then not unfrequent. Some years previously had taken place the "bread and butter rebellion," caused by the poor quality of board that the students were receiving. Neither their physical nor their intellectual food seems to have been palatable to them. The "conic sections rebellion" was a refusal, on the part of the Sophomores, to recite in the manner prescribed by the college rules. They petitioned that the method of recitation required by the college be changed, that they might "explain conic sections from the book, and not demonstrate them from the figure."<sup>\*</sup> We should judge from this that the practice had hitherto prevailed of simply asking the student to explain certain parts of the subject, with the book open before him, without requiring him to go to the blackboard (if blackboards were used) to explain the lesson from his own figure independently of the book. We have not been able to ascertain at what time the blackboard was introduced into the mathematical class-room at Yale, but it is not unlikely that the above rebellion arose in the attempt, on the part of the faculty, to introduce such improved methods as the use of the blackboard would suggest. The new methods may have called for greater effort on the part of the student, and may thus have brought about the "rebellion."

The general impression prevailed at Yale, in those days, that the mathematical course there was a very difficult and thorough one. "This fancy certainly derived some support from comparison with the classical course, as compared with which the mathematical was undoubtedly a good one."<sup>†</sup>

Mr. Bristed, who entered Yale in 1835, says that in mathematics the classes studied books rather than subjects, and crammed from one day to another. "A great deal of the work," says he "of the second and third year consisted of long calculations of examples worked with logarithms, which consumed a great deal of time without giving any insight

<sup>\*</sup> Yale College: a Sketch of its History, by William L. Kingsley, p. 137.

<sup>†</sup> Five Years in English Universities, by Charles Astor Bristed, 3d ed., 1873, p. 456.

into principles, and were equally distasteful to the good and the bad mathematicians." "They (the best mathematicians) complained that with the exception of two prizes for problems during the Freshman and Sophomore years, and an occasional 'original demonstration' in the recitation room, they had no chance of showing their superior ability and acquirements; that much of their time was lost in long arithmetical and logarithmical computations; that classical men were continually tempted to 'skin' (copy) the solutions of these examples, and thus put themselves unjustly on a level with them." The bad practice of giving long and tedious examples to work has been quite prevalent in our colleges until within recent years, especially in trigonometry. For ordinary class-work four-place logarithmic tables are sufficient, we should think. Prof. J. M. Peirce, of Harvard, has done much toward inaugurating a reform in this matter, by his publication of four-place tables. Such tables are of sufficient accuracy even in connection with the ordinary physical experiments which the student may make in the laboratory.

In 1836 Anthony D. Stanley became professor of mathematics. He held this place until his death in 1853. He was a native of Connecticut and graduated at Yale in 1830. Two years later he was appointed tutor and afterward professor. We are told that Professor Stanley took special interest in the theory of numbers, and that he had once an excellent occasion to show his skill. "In 1835 an anonymous writer in the Stamford Sentinel challenged the entire faculty of Yale to arrange the nine digits in such order that their square root could be extracted without a remainder. In a few days Mr. Stanley over the signature "X" gave the required solution, and added that the question admitted of more than one answer, and called upon the proposer to produce them. To this challenge his opponent made an evasive reply, in which he stated the number of solutions to be nine, but did not communicate any solution."\* Stanley found twenty-eight different solutions, but even a larger number is possible.

It seems that when Stanley was appointed professor he did not immediately enter upon the discharge of the duties of the chair, but went to Europe two years and spent most of the time in Paris, where he attended lectures at the Sorbonne and College of France. In 1846 he published Tables of Logarithms, which were uncommonly accurate. In 1848 appeared his Elementary Treatise on Spherical Geometry and Trigonometry. In the preceding year he published an article in the American Journal of Science, "On the Variation of a Differential Coefficient of a Function of any Number of Variables." "In this memoir," says Professor Loomis, "he resolves a problem which had already occupied the attention of La Grange, Poisson, Ostrogradsky, and Paganini, the latter of whom was the only one who obtained a correct solution of it. Professor Stanley here gives a solution of the same problem more

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Yale College: a Sketch of its History, by William L. Kingsley.

simple and concise than Pagani's, and which was discovered before receiving the solution of that mathematician."\* In 1849 he suffered from a severe cold, and he sought relief in Italy and Egypt. On his return he assisted in completing the revision of Day's Algebra, which he had begun before leaving. He died in 1853.

Somewhat later than Prof. Charles Davies, Prof. Elias Loomis began the publication of mathematical text-books, which, like Davies' works, became extremely popular throughout the United States. Professor Loomis has been connected with Yale College since 1860, but not as professor of mathematics. Indeed, his specialty has not been mathematics. His original contributions to science have been in other fields. At Yale he has been professor of natural philosophy and astronomy. His chief scientific work has been as a meteorologist and astronomical observer. In his younger days Professor Loomis was a man of wonderful activity, but now he is nearly four score years old and an invalid.

Professor Loomis was born in Connecticut in 1811; was graduated at Yale College in 1830. After graduating he occasionally contributed solutions to Ryan's Mathematical Diary. He was for a time tutor in Yale. Together with Professor Twining, of West Point, he made observations for determining the altitude of shooting-stars. These were, most likely, the first concerted observations of the kind made in America. He was the first one in America to discover Halley's Comet in 1835. The next year he was chosen professor of mathematics and natural philosophy at the Western Reserve College, with permission to spend a year in Europe. In Paris he attended lectures of Arago, Biot, Poisson, Dulong, Pouillet, and others. He returned with astronomical, physical, and meteorological instruments, and during the next season an astronomical observatory was erected at the Western Reserve College, in Ohio. Only three observatories existed in the United States before this, namely, at the University of North Carolina, at Yale, and at Williams College.

In 1844 Professor Loomis became professor in the University of the City of New York. "Having here no instruments for observation, he was induced to undertake the preparation of a text-book on algebra; especially designed for the use of his own classes. This book prepared the way for a second, and the second was followed by a third, until, ultimately, his text-books embraced the whole range of mathematics and natural philosophy, astronomy, and meteorology."\* His principal mathematical and astronomical text books are, Plane and Spherical Trigonometry, 1848; Analytical Geometry and Calculus, 1857; Elements of Algebra, 1851; Elements of Geometry and Conic Sections, 1851; Practical Astronomy, 1855; Elements of Arithmetic, 1863. His treatise on astronomy, now obsolescent, received in its day high commendation from leading astronomers. Some of his mathematical text-books were, at first, very thin, but were gradually enlarged in subse-

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\* Yale College; a Sketch of its History, by William L. Kingsley.

quent editions. Thus, his *Analytical Geometry and Calculus* were at first combined in one small volume, while, subsequently, the two subjects were published separately in volumes about as large, each, as the earlier combined volume.

The books of Loomis were written in a clear, simple style, and were well adapted for use in the class-room. There was nothing in them which any student of ordinary ability and application did not readily master. These characteristics made Loomis's works very popular. A student desiring to secure a somewhat extended knowledge of the various mathematical subjects would hardly have found Loomis's works to answer his purpose; nor would the works of Davies have given him better satisfaction. He would have found more of what he wanted in the books of Peirce and Chauvenet. Nor were Loomis's works always up with the times. The treatment of series is bad, both in his *Algebra* and in his *Calculus*. Again, take the following statement, for instance: "No general solution of an equation higher than the fourth degree has yet been discovered."\* This piece of historical information is unsatisfactory; for, in the first place, M. Hermite has given a *transcendental* solution of the quintic and, in the second place, Abel and Wantzel have proved that an *algebraic* solution of equations higher than the fourth degree is impossible. Perhaps the best mathematical work, in point of accuracy, is his *Elementary Geometry*. It has been said of American writers that, while they have given up Euclid, they have modified Legendre's *Geometry* so as to make it resemble Euclid as much as possible. This applies to Loomis with greater force, perhaps, than to any other author. His trigonometry has been wedded to the old "line system," and it is only within the last two or three years that a divorce has been secured.

While Loomis has made no original contributions to pure mathematics, he has not been idle in other lines of research. He has contributed one hundred or more papers chiefly on astronomical, meteorological, and physical subjects to the American Philosophical Society, Connecticut Academy, Smithsonian Institution, American Journal of Science, and Gould's Astronomical Journal. Some of his papers have been reprinted in Europe. His *Contributions to Meteorology* was translated into French.

Professor Stanley's successor in the mathematical chair at Yale is Professor Hubert Anson Newton. He graduated at Yale in 1850, after which he studied higher mathematics. In 1852 he was made tutor, and when he entered upon that office in 1853 he was given charge of the entire mathematical department at once, owing to the illness of Professor Stanley. In 1855 he was elected full professor, with permission to spend one year abroad. In 1856 he began the active discharge of the duties of the chair, which he still holds. Professor Newton's publications have been restricted almost exclusively to scientific papers, which

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\* *Treatise on Algebra*, 1873, p. 334.

have appeared in the *Memoirs of the National Academy of Sciences* and in the *American Journal of Science*. He is best known to science for his observations on shooting-stars and star-showers. He wrote for the *Encyclopædia Britannica* the article on "Meteorites." His work in pure mathematics includes a paper "On the Construction of Certain Curves by Points," published in the *Mathematical Monthly*, and on "Certain Transcendental Curves."

Since 1871 Eugene L. Richards has been assistant professor of mathematics. He is the author of a *Trigonometry*.

In 1873 John E. Clark, who had been professor at the University of Michigan, was chosen professor of mathematics at Yale. Since 1881 Andrew W. Phillips has been assistant professor of mathematics; also William Beebe since 1882. Phillips and Beebe have written a novel and successful treatise on *Graphic Algebra*.

In 1871 J. Willard Gibbs was elected professor of mathematical physics. He graduated at Yale in 1858, and after graduation continued his mathematical and physical studies. He was tutor from 1863 to 1866. Afterward he went to Europe and spent three years in study at Paris, Berlin, and Heidelberg. Much of his time has been given to thermodynamics. He contributed in 1873 to the *Connecticut Academy* an article on *Graphical Methods in Thermodynamics of Fluids*. In the same year appeared *A Method of Geometric Representation of the Thermodynamic Properties of Substances by Means of Surfaces*.

But Professor Gibbs's studies have been carried on also in the field of pure mathematics. He has published a treatise on the *Elements of Vector Analysis*, which is a triple algebra, as distinguished from quaternions, a quadruple algebra. Vector analysis has been applied by Professor Gibbs to about the same kind of problems as quaternions. The advantage claimed for vector analysis over quaternions is that the former reaches solutions more simply and directly, and that its principles can be developed more concisely. In 1886 Professor Gibbs read an exceedingly interesting paper before the *American Association for the Advancement of Science* on *Multiple Algebra*, which contains an excellent sketch of the development of this science in the hands of Grassman, Hamilton, Hankel, Benjamin Peirce, Sylvester, Cayley, and others. As to the applications of multiple algebra, Professor Gibbs says:\*

"Maxwell's *Treatise on Electricity and Magnetism* has done so much to familiarize students of physics with quaternion notations that it seems impossible that this subject should ever again be entirely divorced from the methods of multiple algebra.

"I wish that I could say as much of astronomy. It is, I think, to be regretted that the oldest of the scientific applications of mathematics, the most dignified, the most conservative, should keep so far aloof from the youngest of mathematical methods."

We now return to the courses of study at Yale College. The catalogue

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\* *Proceedings American Association for the Advancement of Science*, 1886, p. 62.

of 1845 shows that "Day's Algebra to quadratics" was added to "arithmetic" as a requirement for admission to college. In 1852 Thomson's was the arithmetic recommended. In 1855 the requirements were again increased by the addition of two books in Playfair's Euclid. In 1870 the terms were higher arithmetic, Loomis's Algebra to quadratics, and two books of Playfair's Euclid (or the first, third, and fourth books of Davies' Legendre, or of Loomis' Elements of Geometry); in 1885, arithmetic, algebra as far as logarithms in Loomis, first book in Euclid, and the first thirty-three exercises thereon in Todhunter's edition (or the first four books in another geometry); in 1887, higher arithmetic (including the metric system of weights and measures), algebra (Loomis as far as logarithms), plane geometry. All candidates for admission are examined on the same studies, no matter what courses they may wish to pursue in college. It is also worthy of remark that, since 1885, the use of Euclid as a text-book in geometry has been discontinued at Yale, and Princeton is now the only prominent college in the country which still adheres to Euclid.

We come now to the mathematical course in college. In 1848 it was as follows:

*Freshmen*, Day's Algebra, Playfair's Euclid; *Sophomores*, Day's Mathematics, Bridge's Conic Sections, and Stanley's Spherical Geometry and Trigonometry; *Juniors*, Olmsted's Natural Philosophy, Mechanics, Hydraulics, Hydrostatics, Olmsted's Astronomy, Analytical Geometry or Fluxions (optional).

Fluxions seem to have been optional all the time, though in previous catalogues they appear as a regular study. Analytical geometry was also optional for that year. In 1852 Loomis's Analytical Geometry and Calculus appear in the catalogue as Sophomore studies. In 1854 Bridge's Conic Sections or Analytical Geometry appear as part of the work of the Sophomore year; and Church's Differential Calculus in the Junior year. But analytical geometry and calculus were elective studies. "Those desirous of pursuing higher mathematics are allowed to choose *analytical geometry* in place of *regular mathematics* in the third term Sophomore, and calculus in the Junior for Greek and Latin."

In 1858 Loomis's Calculus is given in the Sophomore year, and Todhunter's in the Junior.

The course was as follows in 1870: *Freshmen*, Loomis's Algebra, Playfair's Euclid, Loomis's Conic Sections; *Sophomores*, Loomis's Trigonometry, Stanley's Spherical Geometry, Davies' Analytical Geometry; *Juniors*, Calculus, Loomis's Astronomy. The next year, Chauvenet's Geometry was used with Euclid in the Freshman class.

In 1885 the course was—*Freshmen*, Todhunter's Euclid (Books III and IV), Chauvenet's Geometry, Richard's Plane Trigonometry, Phillips and Boole's Graphic Algebra; *Sophomores*, Loomis's Analytical Geometry—plane and solid, Dana's Mechanics; *Juniors*, Loomis's Astronomy—required, Calculus, Geodesy, Descriptive Geometry (all three elective); *Seniors*, Calculus, Vector Analysis (both elective).

The course for the year 1887-88 is substantially the same as that of 1885. We quote from the catalogue the following account of it:

"In geometry the exercises consist in recitations from the text-book, the original demonstration of theorems, and applications of the principles to the solution of numerical problems.

"After the student has gained facility in the use of trigonometrical tables, the principles of plane trigonometry are applied to the problems of mensuration, surveying, and navigation, and those of spherical trigonometry to the elementary problems relating to the celestial sphere.

"In algebra the elementary principles of the theory of equations are illustrated graphically, and the student is exercised in the numerical solution of equations of the higher degrees and the graphical representation of the relations of quantities.

"In analytical geometry the student is carried through the elementary properties of the lines and surfaces of the second degree, and is introduced to the theory of map projection.

"These are studies of the Freshman and Sophomore years, and, together with the elements of astronomy which are pursued in Junior year, are regarded as essential parts of a liberal education.

"In the Junior and Senior years opportunity is given in the elective courses to obtain a wider knowledge of analytical geometry and trigonometry with their applications to geodesy and astronomy. A longer and shorter course are provided in Junior year in differential and integral calculus. The shorter course is designed for students who desire to become acquainted with the methods of the calculus, but whose principal studies are not of a mathematical character. The longer course is designed for such as expect to make a serious study of any department of pure or applied mathematics.

"In Senior year advanced subjects in the calculus and the elements of analytical mechanics form one line of study.

"An elementary and an advanced course are provided in what is called vector analysis. The object of these courses is to introduce the student to the methods of multiple algebra in geometry, mechanics, and physics. The matter taught is not entirely unlike that usually given in courses in quaternions, but the method followed is in some respects nearer to Grassmann's than to Hamilton's. The elementary course is confined to the simplest algebraic relations of vectors. The advanced course includes differentiation with respect to position in space, and the theory of linear vector functions.

"Students who show special aptitude are exercised in the working up of subjects which require the use of the library and more prolonged investigation than the daily exercises of the class-room. Such work begins in Freshman year. There is a considerable collection of models, which are used to assist the imagination in the various branches of study."

In November, 1877, a Mathematical Club was formed at Yale. Pro-



fessor Gibbs has been the leading spirit in it. He has, in recent years, presented papers showing the application of vector analysis to the computation of elliptic orbits. The work of the club has, however, not been confined to pure mathematics. Professor Newton has presented subjects on meteors and astronomy, and Professor Hastings has given results of experiments made by him on light.

#### COLLEGE OF NEW JERSEY.

In 1830 Albert B. Dod became professor of mathematics. He seems to have been a favorite teacher. His pupils cherish fondly the recollection of "his brilliant genius and the interest which he infused into the study of higher mathematics, as well as the magnetic charm of his manner, as by the wonderful acuteness and perspicuity with which he mastered and explained the most abstruse problems." The same qualities shone attractively in his lectures on architecture.\* He discharged the duties of his office with signal ability till his death, in 1845. The family to which he belonged had for several generations been remarkable both for mathematical taste and talent. His father constructed the engine of the *Saranah*, the first steam boat that crossed the Atlantic.

The scientific and mathematical departments of Princeton were first made prominent by the labors of Professors Henry and Alexander. Stephen Alexander was graduated at Union College, New York, in 1824, at the age of eighteen, with high honors. He then engaged in teaching. In 1829 and 1831 he was in Albany making numerous astronomical observations and communicating them to the Albany Institute. He and Joseph Henry were relatives. "Professor Henry was a son of the elder Alexander's sister, and in 1830 he married his cousin, Miss Alexander, thus establishing a double relationship, which unquestionably shaped the whole life and fortune of his younger and favorite cousin and brother-in-law." In 1832 Professor Henry was elected to the chair of natural philosophy at the College of New Jersey. Alexander went with Henry and his family to Princeton. He there entered the Theological Seminary as a student, but in 1833 he was appointed tutor in the college. "In 1834 he was made adjunct professor of mathematics, and in 1840 he was promoted to the full professorship of astronomy, which he retained until 1876. During the long intervening period the style and duties of his professorship were several times more or less modified. For several years after the death of Professor Dod he was professor of mathematics and astronomy. When Professor Henry went to Washington he gave up the mathematics and became professor of natural philosophy and astronomy, but he always held fast to astronomy."

In 1847 John Thomas Dartnall became connected with the mathemati

\* *Harvardiana*, p. 117.

<sup>1</sup> *Harvardiana*, p. 117. <sup>2</sup> *Annals of the Academy of Sciences*, Vol. II, p. 385. <sup>3</sup> *Biographical Memoirs of Stephen Alexander*, by C. A. Young. Our remarks on Professor Alexander are drawn chiefly from this sketch.

cal department. He graduated at Princeton College in 1841, afterward studied theology, and then was appointed tutor in Greek. From 1847 to 1850 he served as adjunct professor of mathematics. During two years he had charge of a Presbyterian church in connection with his duties in the college. He published, also, a volume of sermons. He has been professor of mathematics since 1850. For many years the mathematical teaching at Princeton was in the hands of Professor Duffield and Professor Alexander. The former possessed great power in teaching young students, while the latter led their way into the more advanced mathematics and astronomy.

In 1850 the requirements for admission were arithmetic and the elements of algebra through simple equations. The *Freshmen* studied Hackley's Algebra and Playfair's Euclid; the *Sophomores* finished Euclid and then took up plane and spherical trigonometry, navigation, etc.; the *Juniors* studied analytical geometry (Young's), Alexander's Differential and Integral Calculus, and mechanics.

Princeton is one of the very few colleges in this country which have retained Euclid as a text-book in geometry to the present day. "Euclid is used as a text-book in geometry because of its historical associations and its decided superiority for the purpose of mental discipline to any modern text-book."<sup>\*</sup>

Rev. Dr. R. G. Hinsdale, who was a student at Princeton from 1852 to 1856, gives the following reminiscences of the mathematical teaching there: "The requirements for admission were geometry—four books of Euclid, algebra through quadratics. The text-book in algebra during the Freshman year was Hackley's. The fact was, that but few who entered were fully prepared, and therefore we had a rapid review of the subjects *ab initio*, finishing Hackley the first year. In the Sophomore year we finished Euclid's geometry, also surveying and navigation (elementary). Both subjects were taught in a special way by Prof. John T. Duffield, whose syllabus taken down from dictation was a marvel of clearness. The notes of that syllabus I have with me. It has never been printed. The Junior class studied Young's Analytical Geometry and Conic Sections. The first half of the year we were taught by Professor Duffield, the last half by Professor Alexander, who had the chair of physics and astronomy.

"In the Senior class mathematics was taught by Professor Alexander, a gentleman of marked ability in the higher branches of his departments. He used no text-book in either department. Both subjects were taught orally. An elaborate compendium of mathematical physics was dictated to the class by the professor, accompanied by explanations of formulæ and experimental illustrations. The same way was adopted by the professor in teaching the mathematics of astronomy. His syllabus in that department, however, was 'printed, not published,' for the use of the class.

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<sup>\*</sup> Catalogue of the College of New Jersey, 1888-89, p. 42.  
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"Professor Alexander had a distinguished reputation among his confrères. Professor Peirce, of Cambridge, spoke of him repeatedly in public lectures as the 'Kepler of the nineteenth century,' always in connection with his theory as to the asteroids, accompanied by mathematical demonstrations that they once formed one wafer-shaped planet which, 'somewhere, somehow,' was shattered into fragments."

Rev. Horace G. Hinsdale says: "He [Alexander] pushed his researches into the depths of mathematical and astronomical science, availing himself of his acquaintance with the principal languages of Europe. He printed for the use of his students treatises on ratio and proportion, differential calculus, and astronomy. He was unselfish in his devotion to the interests of the college and the advancement of learning. He aroused the admiration of his pupils by the evident extent of his knowledge and his ardor in imparting it, although it must be said that he often became so profoundly interested in setting forth the philosophy of mathematics as to forget that their acquaintance with the subject was, of necessity, far less than his own, and so to outrun their ability to follow and comprehend him. The closing lectures in his course in astronomy, in which he discussed the nebular hypothesis of Laplace, were characterized by a lofty and poetic eloquence, and drew to his class room many others than the students to whom they were addressed. Even ladies from the village and elsewhere—so far did the traditional conservatism of Princeton give way before a wholesome pressure—invaded Philosophical Hall."

Professor Young says: "He was familiar not only with the ordinary range of mathematical reading, but with many works of higher order. He had large portions of the *Mécanique Céleste* almost at his finger's ends, and was well acquainted with the works of Newton, Euler, and Lagrange."

As was the case with all college professors in former years, and is still true with most of them, Professor Alexander's time and strength were so consumed by the routine duties of the office, that little remained for anything else. Still he accomplished a great deal. He published articles in various scientific journals, and presented a large number of papers, orally, before scientific societies; and the only record of these communications which we now have is a mere notice or a brief abstract of a paper read on such and such a date.

In 1848 he read before the American Academy for the Advancement of Science a paper on the Fundamental Principles of Mathematics. Prof. C. A. Young says of it: "It is an interesting, suggestive, and eloquent essay. The subject gives the author an opportunity to indulge his inherited Scotch love for metaphysics and hair-splitting distinctions, and he finds in it also opportunity for imagination and poetry to an extent which makes the paper almost unique among mathematical dissertations."

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\*Quoted by Prof. C. A. Young in his memoir.

Professor Alexander was an astronomer, but his special forte was not that of the observer. In fact, he had no adequate instruments or observatory. Long did he labor to secure a good observatory for the college, and, at last, in 1882, a great telescope was pointed toward the stars. "There was something pathetic in his exclamations of satisfaction and delight, for the great instrument, so long dreamed of, had only come too late for him to use it."

In 1876 Alexander was made professor emeritus, and Charles Greene Rockwood became connected with the mathematical department. Professor Rockwood was graduated at Yale in 1864, and, before going to Princeton, was professor of mathematics in Bowdoin and Rutgers successively. He has acquired reputation by his studies of earthquakes, and has contributed articles on vulcanology and seismology to the Reports of the Smithsonian Institution, 1884-86.

From 1878 to 1883 Dr. G. B. Halsted was a teacher in mathematics; until 1881 as tutor, and from that time on as instructor in post-graduate mathematics.

The present mathematical corps consists of Professors John Thomas Duffield, O. G. Rockwood, H. B. Fine, and Tutor H. D. Thompson. O. A. Young is the successor to Alexander as professor of astronomy.

The conservatism of Princeton College is noticeable in some features of the mathematical instruction. Euclid has been retained as a text-book to the present day. Todhunter's edition has been used now for many years. Until recently Loomis's text-books were used largely, though not exclusively. In the academical under-graduate department the following mathematics were taught in 1881: *Freshman* year, Ray's University Algebra, Todhunter's Euclid, and Mensuration; *Sophomore* year, Loomis's Plane Trigonometry, Navigation, Surveying, Spherical Trigonometry, and Analytical Geometry; *Junior* and *Senior* years, Analytical Geometry of two and three dimensions, and Calculus. Under Professor Duffield oral instruction is made prominent. It might be more correct to say that mathematics is taught by him "mainly by lectures—the text-books being used by way of reference, and as furnishing examples for practice." "The students are required to take notes of the lectures and submit their note-books for examination at the end of each term." Until quite recently electives were introduced very sparingly. At present all studies are prescribed during the first two years; mathematics is elective during the last two years.

Modern higher mathematics was first introduced in Princeton College by Dr. G. B. Halsted. His examination papers on quaternions, determinants, and modern higher algebra, are the first ones that have ever been set at Princeton. One feature of the mathematical instruction at this institution that has been in vogue during the last ten years (perhaps longer) is, we think, to be recommended for more general adoption. Considerable attention is given to the study of the history of mathematics. The writer has before him examination papers, writ-

ten in answer to questions set by Halsted in 1881.\* From the answers we infer that questions like these have been asked: Who wrote the first algebra that has come down to us? What was its nature? What part did the Hindoos play in the development of algebra? Its growth during the Renaissance? The laws underlying ordinary algebra? etc.

The present mathematical course, according to the catalogue of 1888-89, is as follows:

For admission to the academical department of the college, the mathematical requirements are: "Arithmetic, including the metric system; algebra, through quadratic equations involving two unknown quantities—including radicals, and fractional and negative exponents; geometry, the first and second books of Euclid, or an equivalent—that is, the propositions in other text-books relating to the straight line and rectilinear figures, not involving ratio and proportion."

Studies in the academical department: "In the Freshman year there are two exercises a week during the first and second terms, in algebra, and two exercises a week during the third term, in plane trigonometry, under Professor Fine; in geometry there are two exercises a week throughout the year, under Mr. Thompson. The text-book in algebra is Wells's University Algebra, to be supplemented by a course on the theory of equations, by the professor. Loomis's Trigonometry is the text-book in trigonometry. Euclid is used as the text book in geometry because of its historical associations and its decided superiority for the purpose of mental discipline to any modern text-book. The first six and the eleventh books of Euclid are supplemented by a course in solid and spherical geometry. Since a thorough knowledge of geometry and familiarity with its more important propositions can be obtained only by extended practice in the demonstration of theorems and problems not contained in the text book, this exercise occupies a prominent place in the course of instruction.

"The Sophomore class has three exercises a week throughout the year in mathematics, under Professor Duffield. For the first term the studies are analytical trigonometry, mensuration, and navigation; for the second and third terms, surveying, spherical trigonometry, analytical geometry, and the elements of the differential calculus.

"In the Junior year mathematics is an elective study. The class has two exercises a week throughout the year, under Professor Duffield. For the first and second terms the studies are analytical geometry and the differential calculus; for the third term, the integral calculus. Loomis's Trigonometry is the text book during the first and second terms of the Sophomore year. Bowser's Analytical Geometry and Calculus during the third term. Sophomore and Junior year—supplemented largely by oral instruction, and numerous exercises in addition to the examples for practice of the text books.

\* One of these was written by Dr. F. J. Morley, class of 1881, professor of mathematics at Princeton and now by A. L. F. Holm, now associate professor of physics at the Johns Hopkins University.

"The Senior class in mathematics (elective) has two exercises a week throughout the year, under Professor Fine. The course for the current year is analytical geometry of three dimensions, differential and integral calculus. Williamson's text-books on the calculus are used, supplemented by lectures on determinants, differentiation and integration of functions of the complex variable, definite integrals."

In 1873 was founded, as a branch of Princeton College, a scientific school called the "John C. Green School of Science." Its courses lead to the degree of bachelor of science. Two years later a course in civil engineering was organized in this school. The mathematics in the scientific school is taught by Professor Rockwood. The course is framed so as to supply the necessary foundation in knowledge and training for the later studies of physics and mechanics, and especially finds its natural continuation in the applied mathematics of the course in civil engineering. Constant blackboard practice is a prominent feature of the instruction. Euclid is supplanted by Chauvenet's Geometry. Other text-books used are Wells's Algebra, Bowser's Analytical Geometry and Calculus. The calculus is begun at the end of the Sophomore year and then finished in the Junior. With the geometry, which is illustrated by models, is combined a thorough course in mensuration and an introduction to the elements of modern geometry. Thus, a synthetic course in conic sections is made to precede analytical geometry—an idea highly to be recommended. Calculus is required of all students in the scientific department. More advanced studies in pure mathematics are elective.

Descriptive Geometry is taught by Professor Willson from Warren's treatise.

In addition to the college courses, there are at Princeton University courses leading to the degrees of master and doctor.

Post-graduate mathematics have been taught since 1831.

"The University courses this year (1888-89) are in differential equations, in the theory of functions, and in higher algebraic curves and surfaces. They are based on the treatises of Forsyth and Boole, Hermite and Clebsch and Gordan, and Salmon and Clebsch, respectively. Professor Fine conducts these courses.

#### DARTMOUTH COLLEGE.

In 1833 Ira Young succeeded Ebenezer Adams as professor of mathematics and natural philosophy. His father was a carpenter, which trade he followed till he attained his majority. He early manifested much mechanical ingenuity. At twenty-one he began a course preparatory to entering college, and graduated at Dartmouth in 1828. He served in the college, first as tutor, then as professor, until his death in 1858. He is said to have been an admirable teacher.

From 1838 to 1851 Stephen Chase was a professor of mathematics at Dartmouth. He was a graduate of this college. While he was pro-

fessor he published an algebra. An old alumnus speaks of him as a teacher, "the light of whose genius, as it gleams through one of our text-books, yet lingers in our halls."

The catalogue for 1834 shows that, since 1828, a remodeling of the college course had taken place. There were now four departments, viz. the classical, mathematical and physical, rhetorical, and the department of intellectual and moral philosophy. The *Freshmen* in the mathematical and physical department studied Playfair's Euclid, reviewed Adams's Arithmetic, and commenced Day's Algebra during the first term; continued Day's Algebra in the second term; and completed Euclid in the third.

The *Sophomores* continued Day's Algebra, devoting their attention to applications to geometry and logarithms. They then took up plane trigonometry and its applications. During the second term Bridge's Conic Sections and Curvature, and Playfair's Spherical Geometry and Trigonometry occupied their attention. They began also Bezout's Calculus, which was finished during the third term. The *Juniors* pursued Olmsted's Natural Philosophy, Day's Mathematics (heights and distances, and navigation), Olmsted's Hydrostatics, and Astronomy. The *Seniors* had no mathematics, according to catalogue.

The next year (1839) indicates several changes. Legendre's Geometry and Bourdon's Algebra displaced old Euclid and Day's Algebra. Davies' Analytical Geometry and Calculus were also used. The influence of the Military Academy at West Point was now beginning to be felt at Dartmouth.

Regarding the mathematical teaching at this time, John M. Ordway, professor of applied chemistry and biology at the Tulane University of Louisiana, writes us as follows: "When I entered Dartmouth College in 1849, the Freshmen were instructed in algebra and geometry by a tutor. We used Davies' Bourdon's Algebra and Davies' Legendre's Geometry. In the Sophomore year we studied Davies' Surveying, and Plane and Spherical Trigonometry, Davies' Analytical Geometry and Davies' Calculus. The instruction was given by Professor Stephen Chase, an excellent scholar, but a somewhat peculiar man. He showed very little mercy to the duller students, and hence was not very popular. The analytical geometry and calculus had not been introduced many years, and it was a sort of traditional idea of the classes that preceded ours, that these subjects were very hard. We, however, did not perpetuate this tradition, for our class as a whole did not find these higher mathematics so very difficult. We had some field exercises in surveying and leveling. The professor went out first with half a dozen chosen students of the class, and they after ward went out with their respective sections of the class. Before our time there had been some solemn burnings of the mathematical text-books at the end of the year, but we had no such nonsense while I was in college.

"Professor Chase also gave the instruction in physics, which was

quite mathematical. He and Professor Young, the father of the present Professor Charles Young, of Princeton, had planned and partly written a work on physics, in which the demonstrations were to be made by the calculus and analytical geometry; but meanwhile Professor Olmsted published his *Natural Philosophy*, and as a matter of courtesy they dropped their own work and introduced the poorer one of Olmsted.\* Olmsted used the common geometry and algebra, and his book was rather old-fashioned and contained some absurd errors. There was one question in the book, 'If the pebble that David threw weighed 2 ounces and Goliath weighed 800 pounds, with what velocity must the stone have moved to prostrate the giant?' The answer given was (about) 2,800 feet per second, or greater than that of a cannon ball. The professor called me up on this question, in the recitation, and asked me if I saw any absurdity in the matter. I told him yes, the answer should have been 2,800, and not 2,800 feet per second. Then the professor went on to explain that Goliath must have had a skull that would be penetrated by a stone moving with much less velocity. He had entirely overlooked the mathematical absurdity of getting a concrete answer out of mere abstract numbers. I went to him after recitation to explain my idea more fully, and told him that had Mr. Olmsted been a Frenchman he would have made the answer 2,800 *meters* per second, and that would have been just as correct, or 2,800 *miles* would have done just as well. This he acknowledged, but seemed never to have thought of it before, the physiological absurdity having shut out from his perception the mathematical error.

"While Professor Chase gave the mathematical teaching of physics, Professor Young lectured on the subject with the help of a very good set of apparatus.

"In the Junior year Professor Young taught astronomy, using Olmsted's *Astronomy* for a text-book. This work was better than the physics, but it rejected the calculus, which would have made many of the demonstrations much plainer. Professor Young was an excellent teacher and was very popular. He could be severe enough, but it was in a quiet, dry way that was not offensive. He would call up a fellow who had not studied the lesson well and put several questions, receiving the wrong answers without any sign of surprise or demur, and finally say, 'The reverse is true,' and call up another man.

"We had some astronomical instruments, but with the exception of the telescope very few of the students ever used any of them. Our examinations in those days were all oral. They were held in the presence of a committee of old graduates summoned to Hanover for the purpose, their expenses being paid by the college. These old fellows

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\* Olmsted's *Introduction to Natural Philosophy* was published in 1831; Young was elected professor in 1833 and Chase in 1838. While Young and, we believe, also Chase, served as tutors before they were appointed professors, it is, nevertheless, not likely that reference can be had, in the above, to the *first* edition of Olmsted's work on natural philosophy.



were rather rusty sometimes and gave the boys some amusement by their occasional old-time questions. The examinations were really a farce, though the results were counted in with the rest of the marks. It was rather funny to see how some fellows who had been rated very low all the year would be made out by the examiners to be among the very best."

In 1849 Chase's Algebra appeared, and began to be used at Dartmouth. Three years later Loomis's series was introduced, excepting his Algebra.

In 1851 Chase was succeeded by John Smith Woodman, of the class of 1842. After graduation he taught school in Charleston, S. C., afterward made a tour through Europe on foot, then studied and practiced law, and finally was elected professor at his *alma mater*.

In 1854 James Willis Patterson, of the class of 1848, became professor of mathematics. He had previously been tutor two years. From 1859 till 1865 he was professor of astronomy and meteorology. He afterward entered politics, was elected to the Legislature and finally to the United States Senate.

About the middle of the present century attempts were made to organize a system of education based chiefly upon the pure and applied sciences, modern languages, and mathematics. Of this class were the scientific schools connected with colleges, such as the Lawrence Scientific School at Harvard, the Sheffield Scientific School at Yale, the School of Mines at Columbia, and the Chandler Scientific School at Dartmouth. These schools have done efficient work and supplied a long-felt want.

The Chandler Scientific School was established in 1851. The instruction was designed to be "in the practical and useful arts of life, comprised chiefly in the branches of mechanics and civil engineering." At first J. W. Patterson is given in the catalogue as Chandler professor of mathematics, but Professor Woodman was the one who labored longest in this school. He taught in it from its establishment, became professor of civil engineering in 1856, and was practically at the head of it. He retained these posts until his death in 1871.

The mathematical course in this school was low at the beginning. Loomis's books were used, also Pussant's Mathematics. Descriptive geometry, shades, and shadows were also introduced.

In the catalogue of 1865, Robinson's series, from the Algebra to the Differential and Integral Calculus, is given. In 1866 Church's Analytical Geometry and Calculus were studied in the Chandler Scientific School. Two years later the college dropped Robinson's series and returned to Loomis's.

Since 1870 the text books used have been, in algebra, Olney, Quimby; in geometry and trigonometry, Olney; in analytical geometry, Loomis, Church, Olney; in calculus, Church, Olney; in analytical mechanics, Peck, Wood; in descriptive geometry, Church; in quaternions, Hardy.

The terms of admission to the college were, in 1828, arithmetic, algebra through simple equations; in 1841, the same; in 1864, the same, with the addition of two books of (Loomis's) geometry; in 1886 and for some years previous, all of plane geometry was required; in 1888, arithmetic, including the metric system, algebra to quadratics, and plane geometry.

The college offers now two courses, one leading to the degree of bachelor of arts, the other (the Latin-scientific course) to the degree of bachelor of letters. The course of study for the year 1888-89 is as follows:

*In the Prescribed Courses, I is in each case an advanced division for students judged to be qualified to pursue a more extended course.*

#### PREScribed COURSES.

##### FRESHMAN YEAR.

1. I. Algebra, including Theory of Equations (Quimby). *Sixty-five hours.*  
II. Algebra. *Sixty-five hours.*
2. I. Solid, with advanced, Geometry (Olney). *Forty-five hours.*  
II. Solid Geometry. *Forty-five hours.*
3. I. Plane trigonometry (Olney), including applications to Surveying; Spherical Trigonometry. *Sixty-two exercises (including ten exercises of field work of three hours each).*  
II. Same as 3, I, omitting Spherical Trigonometry.

##### SOPHOMORE YEAR.

4. I. Analytic Geometry (Olney). *Forty hours.*  
II. Spherical Trigonometry and Conic Sections. *Forty hours.*
5. Surveying with field work and plotting. *Eighty-seven hours.*  
*Course 5 is open only to students of the Latin-Scientific Course.*
6. Descriptive Geometry; Drawing. *Sixty hours.*  
*Course 6 is open only to students of the Latin-Scientific Course.*

#### ELECTIVE COURSES.

7. a. Differential Calculus. } Applications to Analytic Geometry. *Lectures.*  
b. Integral Calculus. } *Ninety-four hours.*  
*Course 7, a and b, is elective with French 2 followed by Mathematics 8.*
8. Elementary Mechanics (Wood). *Fifty hours.*  
*Course 8 preceded by French 2 is elective with Mathematics 7, a and b.*

##### JUNIOR YEAR.

9. Analytic Mechanics; Lectures. *Sixty hours.*  
*Course 9 is open only to students who have completed Course 7, and is elective with Latin and Greek.*
10. Descriptive Geometry; Shades, Shadows, and Perspective (Church). *Forty-four hours.*  
*Course 10 is elective with Latin, Greek, German, Physics.*

The minimum amount of mathematics on which a degree can be obtained, is a course ending with spherical trigonometry and conic sections. Analytic geometry is not necessary.

The course in pure mathematics in the Chandler Scientific School is much the same as the above. The catalogue mentions in that department Olney as the text-book in calculus and Peck as that in analytical mechanics.

In 1860, John E. Varney was appointed professor of mathematics, and served for three years. During the next six years John E. Sinclair filled this position. In 1873 F. A. Sherman, the present professor of mathematics in the Chandler School of Science, was elected. From 1872 to 1878 C. F. Emerson was connected with the mathematical department. Since then he has occupied the chair of natural philosophy and has devoted his energies chiefly to the development of the physical laboratory. P. H. Pettee has been professor of mathematics since 1877, and is now teaching mathematics and engineering in the New Hampshire Agricultural Experiment Station, which is a branch of Dartmouth College. At present T. W. D. Worthen is associate professor of mathematics in the college.

Since 1878 Arthur S. Hardy has been the head of the mathematical department at Dartmouth. He is professor of mathematics and of civil engineering. Previous to the above date he held the professorship of civil engineering in the Chandler Scientific School. Professor Hardy was graduated at West Point in 1869. For three years he was professor of civil engineering at Iowa College. He then spent one year in study at the *École impériale des ponts et chaussées* in Paris, and on his return went to Dartmouth. In 1881 appeared his *Elements of Quaternions*, the first American book on this subject. It is elementary and well adapted for use of those students in our colleges who may desire to know something of the wonderful researches of Sir William Rowan Hamilton. A neat little publication of much interest is Professor Hardy's translation from the French of Argand's *Imaginary Quantities*. He published also *New Methods of Topographical Surveying*, 1884. Professor Hardy possesses two qualifications that are rarely combined; he is a successful mathematician and also a successful novelist.

#### BOWDOIN COLLEGE.\*

In 1825 William Smyth became adjunct professor of mathematics, and in 1828 was given the full chair, which he held until his death in 1868. He was an alumnus of the college. After his graduation, in 1822, he studied theology at Andover, and then became tutor at his *alma mater*. He was led to abandon Greek and take the department of mathematics as an instructor, from his success in popularizing algebra by means of the blackboard.

The introduction of the blackboard in our colleges must have caused important changes in the methods of teaching mathematics, especially geometry. Unfortunately no record of these changes has been preserved except at one or two institutions. We are happily able to quote the following account of its introduction at Bowdoin, taken from the history of the college, written by A. S. Packard. He says (p. 91) that the blackboard was introduced by "Proctor (afterward Professor)

\* We are indebted for the information herein contained chiefly to a communication from Prof. George T. Little, of Bowdoin College.

Smyth in 1824. That novelty, let me here say, made a sensation. When he had tested the experiment in the Sophomore algebra, and with great success, a considerable portion of the Juniors requested the privilege of reviewing the algebra under the new method at an extra hour—a wonder in college experience; and that blackboard experiment, I am sure, led to his appointment as assistant professor of mathematics a year after. Of this also I am sure, that he had then first detected a mathematical element in his mental equipment. His forte had been Greek.”

Professor Packard gives also an interesting account of the modes of teaching immediately before the blackboard came to be used. “The blackboard caused important changes in the manner of teaching generally, but especially in the mathematical branches. In arithmetic, a Freshman study, and algebra, to which we were introduced at the opening of the Sophomore year, each student had his slate, and when he finished his work he took the vacant chair next the teacher’s and underwent examination of the process or principle involved. In geometry we kept a MS., in which we drew the figures and demonstrated from that. I have been shown a very neat MS. kept at Harvard by the late Dr. Lincoln, the father, and bearing the date 1800. \* \* \* It may surprise my hearers that I professed to teach the algebra of the Sophomore class in Webber’s Mathematics—the first tutor, I believe, to whom the duty was entrusted. That was the class of 1824. Franklin Pierce, of the class, in his earlier years of college life, more fond of fun than of surds and equations, took his seat by my side for a quiz with his slate and solution of a problem. When asked how he obtained a certain process; he replied very frankly, ‘I got it from Stowe’s slate.’ \* \* \* With blackboard such transfers are less easy. \* \* \* It will cause more surprise that conic sections in Webber, a Junior branch, fell under my charge. The manner of reciting was simply to explain the demonstration in the text-book.”

In 1834 the requirements for admission were increased so as to include “six sections of Smyth’s Algebra.” These six sections include nearly the entire Algebra, logarithms and the binomial theorem being excluded. In 1867 the requirements were raised so as to read arithmetic, the first eight sections of Smyth’s New Elementary Algebra (to equations of the second degree), and the first and third books of Davies’ Legendre. The requisites remained practically the same from 1867 to 1887, though the text-books recommended were several times changed. Since that time all of plane geometry has been required.

The calculus first appears as a study in the annual catalogue of 1830, the notation of Leibnitz being then used. Fluxions were probably never taught at Bowdoin.

Professor Smyth became an exceedingly able teacher and gained celebrity as a successful writer of mathematical text-books. His publications were, a work on Plane Trigonometry, followed by his Algebra, Analytical Geometry (1855), and Calculus (1856). All of these passed

through repeated editions and enjoyed an extensive sale. As they came from the press they took the place of the Cambridge Mathematics at Bowdoin. In the preparation of his Algebra he followed Bourdon and Lacroix as models, and it contains many of the excellences and some of the defects of these works. A remarkable feature is the very late introduction and explanation of negative quantities. They appear on page 89, after the solution of simultaneous linear equation. In his calculus he uses infinitesimals. "As a logical basis of the Calculus," says he (p. 229), "the method of Newton, and especially that of Lagrange, has some advantage. In other respects the superiority is immeasurably on the side of the method of Leibnitz." At the end of the book he very briefly explains the methods of Newton and Lagrange. A few pages are also given to the "Method of Variations" and "Applications to Astronomy."

The following account of Smyth and his works is taken from an obituary address by his colleague, Professor Packard: "As the first fruit, he issued a small work on Plane Trigonometry, availing himself of the ingenuity of the late Mr. L. T. Jackson, of this town, in preparing blocks on a novel plan for striking off the diagrams. The first edition of his Algebra from the press of Mr. Griffin, of this town, appeared in 1830, which first adapted the best French methods to the American mind, received warm commendation from Dr. Bowditch, and was adopted as a text-book at Harvard and other institutions. It passed through several editions and then gave place to two separate works, the Elementary Algebra and the Treatise on Algebra. Then followed an enlarged edition of the Trigonometry and its application to Surveying and Navigation, and treatises on Analytic Geometry and on the Calculus, the last being so clearly and satisfactorily developed and with so much originality as to receive emphatic approval in high quarters, particularly from the late Professor Bache."

"In explanation he was precise, simple, and clear. He had great power of inspiring interest; his own enthusiasm, which often kindled, especially in certain branches of his department, at the blackboard, being communicated to his class. Later classes will carry through life his setting forth of what he termed the 'poetry of mathematics,' as exemplified in the Calculus."

Of the graduates of Bowdoin during Smyth's time who distinguished themselves in the mathematical line, we mention John H. C. Coffin, class of 1844, who, soon after graduation, was appointed professor of mathematics in the U. S. Navy. He was for many years in the Naval Observatory and, in 1866, took charge of the American Ephemeris and Nautical Almanac.

Professor Smyth's successor, in 1865, was Charles Greene Rockwood, who had graduated at Yale in 1864, and in 1866 received the degree of Ph. D. When he left Bowdoin to accept a position at Rutgers College, in 1873, Charles Henry Smith took his place. In 1887, Professor Smith

was succeeded by Prof. William Alboin Moody, the present incumbent of the chair of mathematics. Professors Rockwood and Smith left the college with the reputation of able and skillful teachers. "The latter was, in my judgment, remarkably successful," says Professor Little, "in securing good and faithful work from all." The writer has before him a report on geometry by Professor Smith, presented to the Maine Pedagogical Society in 1884, and containing some good recommendations on the study of its elements. He strongly recommends a course in empirical geometry of the sort marked out by G. A. Hill's *Geometry for Beginners*, Mault's *Natural Geometry*, and Spencer's *Inventional Geometry*, to precede the course in demonstrative geometry.

Mathematics have never been taught at Bowdoin by lectures, though the instruction has been frequently supplemented by lectures. Since 1880 all mathematics have been elective after the Sophomore year; since 1886, all after the Freshman year. An elective in calculus, not then a required study, was offered from 1870 to 1880. In the year 1882-83 the *Freshmen* studied Loomis's *Algebra*, and Loomis's *Geometry and Conic Sections*, in two parallel courses during the first two terms; the third term of the year being given to Plane Trigonometry (Olney). The *Sophomores* had Olney's *Spherical Trigonometry* during the first term; during the second and third term they had the choice between analytical geometry, and Latin and Greek. Calculus was elective for *Juniors*. In the *Senior* year no mathematics were offered. The text-book in astronomy was Newcomb and Holden. A feature in this mathematical course to be recommended is that analytical geometry is preceded by a short course in conic sections (treated synthetically). The course for the year 1888-89 differs from the preceding in this, that plane geometry is required for admission; that Wentworth's *Algebra* has taken the place of Loomis's; that differential and integral calculus are studies in the second and third terms of the Sophomore year; that an advanced course in calculus (Williamson's) is offered during the first two terms of the Junior year, and quaternions during the third term.

#### GEORGETOWN COLLEGE.\*

From 1831 to 1879 Father James Curley was the head of the mathematical and astronomical department at Georgetown College. He was born in Ireland, October 25, 1796. He entered the Society of Jesus September 29, 1827, and came here in 1830. In 1843 Father Curley built the college observatory. Here he calculated, from his observations, the longitude of Washington. The astronomers at the U. S. Naval Observatory had found a longitude differing a little from Father Curley's result. When, however, the laying of the Atlantic cable

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\* For what material we possess on the teaching at this college we are indebted to the kindness of Prof. J. F. Dawson, S. J., professor of physics and mechanics at Georgetown College.

brought Washington into telegraphic communication with Greenwich, it was found that Father Curley's calculation was the correct one. Since 1879 Father Curley has not been able to teach; he is still living at Georgetown, and is in the full possession of all his faculties.

Since 1839 Father Curley has generally had two assistants, or associates, in mathematics.\*

Rev. James Clark was born October 21, 1800. He entered West Point at the age of sixteen, and graduated in the class of 1829. He served in the Army several years. In 1844 he entered the Society of Jesus, and came to Georgetown in 1845. In 1849 he went to Worcester College, Massachusetts, then recently established, but remained there only one year, returning to Georgetown in 1850. From 1862 to 1867 he was president of Worcester College. He returned to Georgetown in 1867, but was appointed president of Gonzaga College, Washington, in 1869. This office he held until 1875, when he again took his old position in Georgetown. In 1879 Father Clark became unable to teach, and on September 9, 1885, he died at Georgetown. For some years he taught calculus from his own manuscript, and intended to publish a text-book but for some reason did not do so.

About the year 1848, political troubles in Europe induced a considerable emigration to America of some of the most able members of the Society of Jesus, and the faculty of Georgetown College was increased by a considerable accession of learning and talent. We mention as the most conspicuous, Fathers Sestini and Secchi.

Rev. Benedict Sestini was born in Italy, March 20, 1816. He entered the society in 1836. In 1847 he was astronomer of the Roman Observatory. In 1848 he was compelled to leave Italy by the revolutionists, and came to Georgetown. He taught here until 1857; then he taught

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\* During 1830-'32, 1833-'35, 1847-'48, and 1865-'67, Rev. James Ward, S. J., gave instruction in mathematics; 1841-'46, Rev. Thomas Jenkins, S. J.; 1840-'41 and 1842-'43, Rev. Augustine Kennedy, S. J.; 1841-'45, Rev. George Fenwick, S. J.; 1846-'47 and 1849-'51, Rev. Joseph O'Callaghan, S. J.; 1848-'49, Rev. Angelo Secchi, S. J.; 1849-'52, Rev. Edward McNulty, S. J.; 1852-'54, Rev. Anthony Vanden Heuvel, S. J.; 1851-'56, Rev. John Frobergast, S. J.; 1854-'61, 1862-'63, 1870-'71, 1872-'73, Rev. C. Bahant; 1854-'55 and 1871-'74, Rev. G. Strong, S. J.; 1855-'59, 1860-'62, and 1875-'79, Rev. James Clark, S. J.; 1848-'57, and 1863-'69, Rev. B. Sestini; 1853-'64, Rev. Aloysius Vass, S. J.; 1844-'55, Rev. James Major, S. J.; 1867-'69, Rev. Antonio Ciehl, S. J.; 1869-'70, Rev. Patrick Fother, S. J.; 1871-'72, Rev. Patrick Gallagher, S. J.; 1872-'73, Rev. Jerome Daugherty, S. J.; 1873-'74, Rev. Edmund Young, S. J.; 1874-'76, Rev. J. L. G., S. J.; 1874-'78, Rev. M. O'Kane, S. J.; 1878-'80, Rev. J. R. Richards, S. J.; 1878-'81, Rev. Henry T. Tarr, S. J.; 1881-'86, Mr. Thomas McLoughlin, S. J.; 1881-'84, Rev. Timothy Brannan, S. J.; 1882-'84, Rev. John O'Rourke, S. J.; 1884-'85, Rev. Thomas Dwyer, S. J.; 1884-'85, Rev. Thomas Stack, S. J.; 1885-'86, Rev. Samuel H. Frisby, S. J.; 1886-'87, Mr. Joseph Gorman, S. J.; 1887-'88, Mr. David H. Gorman, S. J.; 1888-'89, Rev. John Hagen, S. J.; Rev. John Lehy, S. J.; Mr. James F. Gorman, S. J.; Mr. J. Gorman, S. J.

The frequent changes in the corps of instructors are due to the custom of the Society of Jesus. "In the society a teacher is liable any year to be sent to another college, and is rarely left more than four or five years in one place."

three years in Gonzaga College, two years in Worcester College, and one year in Boston College. In 1863 he returned to Georgetown, where he taught until 1869; he was then removed to Woodstock College. In 1886, advanced in years and broken down in health, he was sent to Frederick, to the novitiate of the society, where he still remains awaiting his end.\* His books were used several years at Woodstock College (the scholasticate of the society). At one time they were in rather extensive use, but at present they have gone out of use almost completely.

Rev. Benedict Sestini published the following mathematical works: *A Treatise on Analytical Geometry*, Washington, 1853; *A Treatise on Algebra*, Baltimore, 1885; *Elementary Algebra*, second edition, 1855(?); *Elementary Geometry and Trigonometry*, 1856; *Manual of Geometrical and Infinitesimal Analysis*, Baltimore, 1871. The method of treatment of the various subjects in these works is not entirely conformable to that generally in vogue in this country at the time of their publication. The last named work is a thin volume of 130 pages, making no pretension of being a complete work on the subject. It was intended primarily for students in the author's own classes at Woodstock College, in Maryland, and as an introduction to the study of physical science.

With Father Sestini came Rev. Angelo Secchi, the astronomer. He was born in 1818, and entered the society in 1833. He was compelled to leave Italy in 1848, on account of the revolution. He remained at Georgetown very little more than a year. In 1850 he returned to Italy, and was placed in charge of the Roman Observatory, where he labored until his death, February 26, 1878.

At present the mathematical course consists of geometry, plane and spherical trigonometry, analytical geometry, differential and integral calculus, mechanics, and astronomy. Algebra is taught in the preparatory department. This course has remained practically the same since 1829, except that the time given to mechanics has been increased.

Elective studies have never been offered at the college, nor has the practice of lecturing ever been in vogue. Since 1829 more time has been given to mathematics than formerly. About the year 1820 the Society of Jesus adopted a new "*ratio studiorum*," or plan of studies, giving to mathematics more attention than had hitherto been accorded to them. This brought about the change at Georgetown in 1829. The methods of the Society of Jesus have been strictly adhered to. "The professor first explains the lesson, pointing out the important parts, the proofs, the connection with other parts of the subject, etc., and giving other proofs if those in the book do not suit him. On the following day he calls on one of the class for a repetition; after the repetition

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\* Professor Dawson has endeavored to find out something about the early life and education of Father Sestini, but with no success. Father Sestini himself can not give any information on the subject; his health has failed very much, and his memory can not be relied upon.



the members of the class bring forward their difficulties, suggestions, etc., after which the following lesson is explained. Problems are frequently given to test the knowledge and inventive powers of the students.<sup>7</sup>

Father Sestini's text-books were used several years. They were replaced by those of Davies. In 1860 Gummere's surveying was introduced, and the Algebra, Geometry, and Trigonometry of Davies; Sestini's Analytical Geometry and Calculus were retained. In 1870 Sestini's Analytical Geometry and Calculus were replaced by Davies' Analytical Geometry and Church's Calculus. In 1872 and 1873 Loomis's Analytical Geometry was used. In 1874 Olney's Algebra, Trigonometry, and Calculus were introduced; Davies' Geometry and Gummere's Surveying were retained. In 1878 the Algebra and Geometry of Loomis were used, and in 1879 his Trigonometry, Analytical Geometry, and Calculus. Two years ago Wentworth's series was introduced, with Taylor's Calculus. Peck's Mechanics was used until 1881, when it was replaced by Dana's. In calculus the notation of Leibnitz has been employed "as far back as we have any records."

At the college observatory no work has been done for some years; but in January, 1889, Rev. John Hagen, S. J., was placed in charge of the observatory and will make regular observations. Father Hagen was formerly at Prairie du Chien, Wis. He is a mathematician of considerable ability and has contributed articles to the *American Journal of Mathematics*.

#### CORNELL UNIVERSITY.\*

When Dr. Andrew D. White entered upon the organization of Cornell University and the selection of a faculty, the first professor appointed was Evan William Evans. He occupied the chair of mathematics at Cornell from the time of its opening, in 1868, till 1872, when he resigned on account of failing health. Professor Evans was a native of Wales, came to this country with his parents when a child, was graduated at Yale in 1851, and studied theology for a year. He then became principal of the Delaware Institute, Franklin, N. Y., was tutor at Yale from 1855 to 1857, and, later, professor of natural philosophy and astronomy in Marietta College, Ohio, where he remained until 1864. Before entering upon his work at Cornell University he was occupied for three years as mining engineer, and spent one year in European travel. He died not long after resigning his position at Cornell.

In the same year that Professor Evans was selected to the mathematical chair, Ziba Hazard Potter, a graduate of Hobart College, was appointed assistant professor of mathematics. This position he held for fourteen years.

\* The author is indebted to the kindness of Professor Oliver for sending annual reports and giving information on the mathematical courses of study at Cornell University.

In 1869 William E. Arnold, major U. S. Volunteers, entered upon the duties of assistant professor of mathematics and military tactics, and served seven years in that capacity.

Appointed as assistant professor at the same time as Professor Arnold, was Henry T. Eddy. He is a native of Massachusetts, was graduated at Yale in 1867, and then studied engineering at the Sheffield Scientific School. In 1868 he became instructor of mathematics and Latin at the University of Tennessee, at Knoxville. At Cornell he received the degrees of C. E. and Ph. D. for advanced studies in pure and applied mathematics. In 1872 he went to Princeton, where, for one year, he was associate professor of mathematics. Since 1874 he has held the chair of mathematics at the University of Cincinnati. The year 1879-80 was spent by him in study abroad.

Professor Eddy has won distinction as an original investigator. His *Researches in Graphical Statics* (New York, 1878) and his *Neue Constructionen in der graphischen Statik* (Leipzig, 1880) are contributions of much value, and, we believe, the first original work on this subject by an American writer. Professor Eddy is contributing largely to scientific and technical journals. In 1874 appeared his *Analytical Geometry*. At the meeting of the American Association for the Advancement of Science, in Philadelphia in 1884, Eddy was Vice-President of Section A, and delivered an address on "College Mathematics." Having been connected as student or teacher with several higher institutions of learning, both classical and scientific, he was able to speak from his own observation and experience of the defects of the mathematical instruction in the United States. His address contains many valuable suggestions.

In 1870 Lucien Augustus Wait, who had just graduated at Harvard, was appointed assistant professor. He held this position for about ten years, when he was made associate professor, which position he still holds. Some time ago he spent one year in Europe on leave of absence. Professor Wait is an energetic and excellent teacher of mathematics.

For three years succeeding 1873 William E. Byerly, a graduate of Harvard, and now professor there, was assistant professor at Cornell University. Professor Byerly is a fine teacher, and by his publications has made his name widely known among American students of the more advanced mathematics.

Since 1877 George William Jones has been assistant professor. He is a graduate of Yale, 1859. He "is thoroughly logical, and the best drill-master" in the mathematical faculty at Cornell University.

As has been seen from the above, two of the former assistant professors at Cornell have since won distinction elsewhere. The same is true of some of the instructors in mathematics. Before us lie the names of the following former instructors in mathematics at Cornell: George Tayloe Winston (one year, 1873, now at the University of North Carolina), Edmund De Breton Gardiner (one year, 1876), Charles Ambrose Van Velzer (one year, 1876, now professor of mathematics at University

of Wisconsin), Madison M. Garver, and Morris R. Conable (each for part of one year, about 1876).

At present there are four instructors, viz: James McMahon (since 1884), Arthur Stafford Hathaway (since 1885), Duane Studley (since 1887), George Egbert Fisher (since 1887).

Mr. McMahon is a graduate of the University of Dublin, Ireland, 1881. He has a fine mathematical mind, and has obtained gold medals for his proficiency in mathematics and mathematical physics, and also an appointment to a scholarship at his *alma mater*. He has not published much, but has assisted in the preparation of text-books on mathematics issued by the Cornell professors.

Mr. Hathaway graduated at Cornell in 1879, and then pursued graduate studies at the Johns Hopkins University, under Sylvester and his associates till 1881. While in Baltimore he frequently contributed papers to the mathematical society at the university, which were subsequently published in the Johns Hopkins University Circulars. He has made the theory of numbers his specialty, and has contributed several original articles on the subject to the American Journal of Mathematics. He gives a new theory of determinately-combining ideals. Mr. Hathaway is not only an able mathematician, but also an expert stenographer. When Sir William Thomson, of the University of Glasgow, delivered a course of lectures on Molecular Dynamics at the Johns Hopkins University, in October, 1884, Mr. Hathaway exercised his "power to seize on every passing sound." These stenographic notes of Thomson's lectures were printed by the papyrograph process and published. At Cornell, Hathaway has assisted in the preparation of text-books, and is now, with Professor Jones, preparing a Projective Geometry.

It will be noticed that Harvard University has contributed the largest share of mathematical talent to the faculty of Cornell. Not only are Byerly and Wait graduates of Harvard, but also Oliver, the present occupant of the mathematical chair at Cornell. These three sat at the feet of that Giant, Benjamin Peirce, and caught the inspiring words of their great master.

James Edwin Oliver was born in Maine, in 1829, and was graduated at Harvard in 1849. He had then already displayed extraordinary mathematical power, and was at once appointed assistant in the office of the American Nautical Almanac, at that time in Cambridge. In the Harvard catalogues of 1854 and 1855 we find J. E. Oliver and T. H. Seeley, of 754's mathematical students in the Lawrence Scientific School, and taking advanced courses of mathematics, such as were offered at that time by no other institution in the land. In 1871 Oliver became assistant professor of mathematics at Cornell, and two years later was in full possession of the chair.

Professor Oliver is an extraordinary man, and it is interesting to listen to what his former pupils have to say of him. Says Prof. C. A. Vas

Velzer: "He is indeed a wonderful man. If Professor Oliver had some of Sylvester's desire for reputation, he would have been heard from long ago, and would have been known all over the world." Says Mr. A. S. Hathaway: "Professor Oliver is a rare genius, powerful, able, but without the slightest ambition to publish his results. He works in mathematics for the love of it: I have seen work of his done one or two years ago. Practically the same work appeared in the *American Journal of Mathematics*, written by prominent authors, that I had urged him to publish, and which he had promised to do, but which, with his characteristic dilatoriness and diffidence in this respect, he failed to do until it was too late. I consider him fully equal in point of natural ability to Professor Sylvester, and he is better able than Professor Sylvester, I think, to acquire a knowledge of what others have done. He lacks, however, the energy and ambition of Professor Sylvester, and does not concentrate his powers on any one subject. His work is im-methodical, and leads in whatever direction his mind is bent at the moment. The result is that he is a far more amiable and congenial person to meet than Professor Sylvester. He never obtrudes self upon you, and wherever you may lead he will follow. Indeed, his simplicity of character and interest in everything that interests anybody else is one of his greatest charms. There are few subjects in which he does not know more than most people—you find it out when you are talking with him—but he does not seem to know it, at least he never obtrudes it."

Professor Wait is described as a "live energetic business manager, who was appointed to the position of associate professor to supplement Professor Oliver's shortcomings, and to take care of the practical management of the department. A better man could not have been chosen to associate with Professor Oliver. The latter finds in Professor Wait a ready promoter of his ideas and plans, and one who is capable of carrying them out in the smallest detail, and of taking charge of the department without troubling the chief."

Professor Jones is a good drill-master. The bulk of the work on mathematical text-books is done by him. His style has been adopted throughout. Professor Oliver's style is more classical and polished, but that of Professor Jones is more suitable for elementary text-books. In consequence, everything written by any one else, has been re-shaped more or less by him.

The mathematical faculty of Cornell have published several text-books, going by the name of "Oliver, Wait, and Jones's Mathematics." The works in question are, a *Treatise on Trigonometry*, a *Treatise on Algebra*, and *Logarithmic Tables*. In preparation are also a *Drill-Book in Algebra*, which will be specially adapted to the work of the preparatory schools, and a *Treatise on Projective Geometry*.

The *Treatise on Trigonometry* has been used successfully at Cornell for eight years, and their *Treatise on Algebra* for two years. "For the

regular classes (in algebra) the more difficult parts have been cut out; but every year nearly all that was omitted by them has been taken up by volunteer classes (all Freshmen) with great satisfaction and profit." After eight years of use the Trigonometry has been wholly rewritten.

The Treatise on Algebra is not a book intended for beginners, but primarily for students entering the Freshman class at Cornell, and who have had extensive drill in elementary algebra. Most of our American colleges would find the book too difficult for use, on account of deficient preparation on the part of students entering.

If we compare Oliver, Wait, and Jones's Algebra with algebras used in our colleges ten or fifteen years ago, we discover most radical differences and evidences of a speedy awakening of mathematical life among us. A great shaking has taken place among the "dry-bones" of American mathematical text-books, and no men "shake" more vigorously than the professors at Cornell. Among the improvements we would mention a clearer statement of first principles and of the philosophy of the subject, the introduction of new symbols, a more extended treatment and graphic representation of imaginaries, and a more rigid treatment of infinite series. With some corrections and alterations in a subsequent edition, we have little doubt that the book will become the peer of any algebra in the English language.

At Cornell great efforts are made to teach the logic of mathematics, but it is hard to attain the desired standard on account of the way that preparatory schools train their pupils. The preliminary training in algebra generally gives students the idea that algebra is merely a mass of rules, and that students have simply to learn the art of applying them. In consequence of this, there is a constant rebellion among the average Freshmen to the logical study of algebra. Formulae and substitutions are his stand-by.

The attendance of students has been very large at Cornell. Compared with some other departments of the university, the teaching force in mathematics has been rather small. In consequence of this, the time and energy of the professors have been taxed unusually by work in the class room. In the appendix to the Annual Report of the President of Cornell University for 1886-87, Professor Oliver speaks of this subject, and also of the general work of the mathematical department. He says:

"We are not unmindful of the fact that by publishing more, we could help to strengthen the university, and that we ought to do so if it were possible. Indeed, every one of us here is now preparing work for publication or expects to be doing so this summer, but such work progresses very slowly because the more immediate duties of each day leave us so little of that freshness without which good theoretical work can not be done.

"A reprint of our algebra, increased to 412 pages, has, however, appeared this year, and has attracted favorable notice from the press and

from distinguished mathematicians. All five of us have in some way contributed to the work; but much more of it has been done by Professor Jones than by any one else. The chapters with which we propose to complete the book deal mainly with special applications, or with topics peculiar to modern analysis. Meanwhile we have successfully used the volume in all the Freshman sections this year. • • •

"The greatest hindrance to the success of the department, especially in the higher kinds of work, lies, as we think, in the excessive amount of teaching required of each teacher; commonly from seventeen to twenty or more hours per week. The department teaches more men, if we take account of the number of hours' instruction given to each, than does any other department in the university. Could each teacher's necessary work be diminished in quantity, we are confident that the difference would be more than made up in quality and increased attractiveness."

From the Report for 1887-88, p. 75, we clip the following:

"Of course one important means toward this end [of securing the attendance of graduate students] is the publication of treatises for teaching, and of original work. A little in both lines has been done during the past year, though less than would have been but for the pressure of other university work, and less than we hope to accomplish next year. Professor Oliver has sent two or three short articles to the *Analyst*,\* and has read, at the National Academy's meeting in Washington, a preliminary paper on the Sun's Rotation, which will appear in the *Astronomical Journal*. Professor Jones and Mr. Hathaway have lithographed a little Treatise on Projective Geometry. Mr. McMahon has sent to the *Analyst* a note on circular points at infinity, and has also sent to the *Educational Times*, London, solutions (with extensions) of various problems. Other work by members of the department is likely to appear during the summer, including a new edition of the *Treatise on Trigonometry*."

As to the terms for admission to the university, in mathematics, the requirements in 1869 were arithmetic and algebra to quadratic equations; but plane geometry also was required for admission for the course in arts. "I judge from an old 'announcement,'" says Professor Oliver, "that in 1868, when the university opened, some students were admitted with only arithmetic." In recent years the requirements have been arithmetic, algebra through quadratics, radicals, theory of exponents, and plain geometry. In the engineering and architectural courses solid geometry has been added.

In and after 1889, candidates will have two examinations, the "primary" and the "advanced." The "primary" examination will cover the following subjects in mathematics:

In *Arithmetic*, including the metric system of weights and measures; as much as is contained in the larger text-books.

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\* The name of the mathematical journal in question is not *Analyst*, but *Annals of Mathematics*.

In *Plane Geometry*; as much as is contained in the first five books of Chauvenet's *Treatise on Elementary Geometry*, or in the first five books of Wentworth's *Elements of Plane and Solid Geometry*, or in the first six books of Newcomb's *Elements of Geometry*, or in the first six books of Hamblin Smith's *Elements of Geometry*.

In *Algebra*, through quadratic equations, and including radicals and the theory of exponents; as much as is contained in the corresponding parts of the larger treatises of Newcomb, Olney, Ray, Robinson, Todhunter, Wells, or Wentworth, or in those parts of Oliver, Wait, and Jones's *Treatise on Algebra* that are indicated below, with the corresponding examples at the ends of the several chapters: Chapters I, II, III; Chapter IV, except theorems 4, 5, 6; Chapter V, except §§ 3, 5, and notes 3, 4, of problem 2; Chapter VII, § 11; Chapter VIII, §§ 1, 2, the first three pages of § 8 and § 9; Chapter XI, except § 2, problem 9 of § 12, and §§ 13, 17, 18.

For admission to the course leading to the degree of bachelor of arts, no further knowledge of mathematics will be necessary, in any case.

For admission to the courses leading to the degrees of bachelor of philosophy, bachelor of science, bachelor of letters; to the course in agriculture; and (in and after 1890) for all optional students, there will be required, in addition to the "primary" examination, an "advanced" examination in two advanced subjects, "one of which must be French or German or mathematics." If the applicant chooses mathematics, he will be examined on all the Freshman mathematics, namely, solid geometry and elementary conic sections, as much as is contained in Newcomb's *Elements of Geometry*; advanced algebra, as much as is contained in those parts of Oliver, Wait, and Jones's *Treatise on Algebra* that are read at the university (a list is sent on application to the Registrar); and trigonometry, plane and spherical, as much as is contained in the unstarred portions of Oliver, Wait, and Jones's *Treatise on Trigonometry*.

It was the desire of Mr. Cornell and President White to establish a university giving broad and general training, in distinction to the narrow, old-fashioned college course with a single combination of studies. The idea was well expressed by Cornell when he said that he trusted the foundation had been laid to "an institution where any person can find instruction in any study." We shall proceed to give the course of study in mathematics, and let the reader judge for himself whether or not the idea of the founder has been carried out in the mathematical department.

We begin with studies which have been *required* for graduation. The mathematical course has always included, for all candidates for baccalaureate degrees except (at one time) a few natural history and analytic chemistry students, one term each of solid geometry, advanced algebra, and trigonometry (either plane, or plane and spherical). At one time students in history and political science had one term of theory of probabilities and statics instead of spherical trigonometry. There have also always been required in all engineering courses and in architecture, analytic geometry and calculus; and, sometimes, analytic geometry in certain other courses, as those in science and philosophy. At present the amount required is one term of analytic geometry and one term of

calculus, in the course of architecture, and one term of analytic geometry and two terms of calculus in the engineering course. At present, the students in mechanical and electric engineering take also an extra term in projective geometry and theory of equations in the Freshman year. These are the "required" mathematics in the different courses.

In addition to these, "elective" mathematics has always been offered by the university to upper classmen, and also, of late years, to Freshmen and Sophomores. The number of these elective courses has gradually increased, till now they are as follows (Register 1888-89):

#### ELECTIVE WORK.\*

[Any course not desired at the beginning of the fall term by at least three students, properly prepared, may not be given.]

11. Problems in Geometry, Algebra and Trigonometry, supplementary to the prescribed work in those subjects, two hours a week. Professor JONES.

12. Advanced work in Algebra, including Determinants and the Theory of Equations, two hours a week. Professor WAIT.

13. Advanced work in Trigonometry, one hour a week. Professor WAIT.

[The equivalents of courses 8, 12, and 13 are necessary, and course 11 is useful, as a preparation for most of the courses that follow.]

14. Advanced work in Analytic Geometry of two and three Dimensions, viz:—

(a) First year, Lines and Surfaces of First and Second Orders. 3 hours. Professor JONES.

(b) Second year, General Theory of Algebraic Curves and Surfaces. 3 hours. Professor OLIVER.

15. Modern Synthetic Geometry, including Projective Geometry. 2 hours. Professor JONES.

16. Descriptive and Physical Astronomy. 3 hours. Mr. STUDLEY.

17. The Teaching of Mathematics. Seminary work. 1 hour. Professor OLIVER, and most of the teachers in the Department.

18. (a) Mathematical Essays and Theses: (b) Seminary for discussion of results of students' investigations. Professor OLIVER.

19. Advanced work in Differential and Integral Calculus. 3 hours. Mr. FISHER.

20. Quantics, with Applications to Geometry. Requires courses 8, 12, 14 (a), and preferably also 11, 13, 19. May be simultaneous with 14 (b). 3 hours. Mr. MCMAHON.

21. Differential Equations: to follow course 19. 3 hours. Mr. HATHAWAY.

22. Theory of Functions. Requires course 19, and preferably 21. (a) First year, 3 hours. (b) Second year, 2 hours. Professor OLIVER.

23. Celestial Mechanics. 3 hours. Professor OLIVER.

25. Finite Differences. 2 hours. Professor OLIVER.

27. Rational Dynamics. Professor WAIT.

24. Molecular Dynamics; or, 29, Theory of Numbers. 3 hours. Mr. HATHAWAY.

30. (a) Vector Analysis; or, (b) Hyper-Geometry; or, (c) Matrices and Multiple Algebra. 2 hours. Professor OLIVER.

31. Theory of Probabilities and of Distribution of Errors, including some sociologic applications. 2 hours. Professor OLIVER, or Professor JONES.

41. Mathematical Optics, including Wave Theory and Geometric Optics. 2 hours. Professor OLIVER.

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\* Numbers 1 to 10, inclusive, refer in the catalogue to *required* studies in mathematics.



43. Mathematical Theory of Sound. 3 hours. Mr. McMAHON.

44. Mathematical Theory of Electricity and Magnetism. Professors OLIVER and WALL.

In most of the above branches of pure mathematics, an additional year's instruction, for 2 hours per week, may be given if desired.

For several years (from 1874 to 1887, we believe) there has been also a "course in mathematics," with a fixed curriculum, leading to the degree of "bachelor of science in mathematics," but it was dropped when the numerous prescribed curricula and resulting degrees were consolidated into a few "general courses," of which the work is mainly prescribed in the first two years and mainly elective in the last two, and a few "technical courses," whose work is mainly prescribed throughout. That old "course in mathematics" comprised some language and culture studies, botany, geology, logic, English literature, descriptive geometry, analytical mechanics, lectures and laboratory work in physics, while, perhaps, two-fifths of all the student's time was given to pure mathematics, including analytical geometry, calculus, differential equations, finite differences, quaternions, imaginaries, mathematical essays, seminary work, etc. The object of this course was to give the best equipment to students intending to become teachers of mathematics, professors, and investigators. The students in this course were few, but earnest, and some of them have since been making their mark as teachers and investigators.

As to the mathematical text books which have been used at different times, we make the following statement:

In Elementary Geometry, Loomis till about 1873; since then, Chauvenet.

In Elementary Geometrical Conics, Loomis, then Peck, though the present professors "don't much like either."

In Modern Synthetic Geometry, Professor Evans used no book, but gave lectures. The same has sometimes been done since. At other times, Greenleaf's *Geometrical Propositions*, or the recent English translation, was used, or, at times, a little lithographed treatise on Projective Geometry, written for the purpose by Jones and Hathaway, is being used. Professor Oliver has tried, also, Casey's *Sequel to Euclid*, and, once, Salmon's *Conics*.

In Trigonometry, first Evans, then Davies' *Foundon*, Olney, Wells, Newcomb, and, finally, Oliver, Wall, and Jones's, Todhunter's, Burside and Parker's, and, finally, *Trigonometry*.

In Determinants, Allen, Dodson, Hanus, and lectures.

In Algebra, Salmon's *Higher Algebra*.

In Geometry, first Loomis's, including a little of mensuration, then Allen, then Evans, then Greenleaf's, Chauvenet's, Wheeler's, and, finally, Oliver, Wall, and Jones's, Todhunter's.

In Analytical Geometry, first Loomis, for two dimensions; and Davies' *Foundon*, for three dimensions; then Evans, then Peck, Todhunter, Aldis, and Newcomb, for the work with the three dimensions by lecture. With

more advanced students have been used also Salmon's Conic Sections, Higher Plane Curves, and Analytic Geometry of Three Dimensions.

In Differential and Integral Calculus, first Loomis and Church, then Peck, Todhunter, Williamson, Taylor, Meunier-Joannet, Homersham Cox, Woolhouse, Smyth, Byerly; and now Taylor for the few students in the one-term course, the abridged Rice & Johnson's Differential and Rice's Integral Calculus (one term each) for the two-term course for engineers, and Williamson and Todhunter for advanced work, with Bertrand for occasional reference and special work.

In Imaginaries, Argand was used, but now preference is given to Chapter X of Oliver, Wait, and Jones's Algebra.

In Equipollences, Belavitis was once used.

In Quaternions, Kelland, Tait, Hardy, Hamilton's Lectures, Hamilton's Elements.

In Theory of Functions there have been used Laurent's *Fonctions Elliptiques*, Hermite's *Cours d'Analyse*; and now Briot and Bonquet's *Théorie des Fonctions Elliptiques* and Halphen's *Traité des Fonctions Elliptiques*.

In Theory of Numbers, Dedekind's edition of Lejeune Dirichlet's *Zahlentheorie* has been used recently.

In Least Squares, Merriman.

In Differential Equations, Boole, Forsyth.

In Finite Differences, Boole.

In Descriptive Astronomy, Loomis, Newcomb, and Holden, with Young's "The Sun" and Chauvenet (for eclipses) for collateral reading.

In Mechanics, Duhamel's *Mécanique Analytique*, and now Minchin's Analytical Statics and Williamson's Analytical Dynamics.

Quaternions have not been taught now for several years, because the professors are convinced that the benefit of that study is with most students better gotten with a mixed course in matrices, vector addition and subtraction, imaginaries, and theory of functions.

Among the fundamental ideas of President White, in organizing the university, was a close union of liberal and practical education. There have, therefore, from the beginning, existed separate departments of civil engineering, of mechanic arts, and of physics, each with a separate professor at its head. Astronomy is taught partly in the department of civil engineering and partly in that of mathematics.

Pupils in mathematics are always encouraged to do original work, but it is only by older and maturer students that researches are made which are of sufficient value to merit publication. The writer has before him two printed theses, written to secure the degree of doctor of philosophy at Cornell University. One is by C. E. Linthicum, "On the Rectification of Certain Curves, and on Certain Series Involved" (Baltimore, 1888); the other is by Robin A. Harris, on "The Theory of Images in the Representation of Functions" (Annals of Mathematics, June, 1888). Both of these are very creditable to the writers and to the university, and the latter appears to us to fill a gap.

There are always some under-graduate students who do good work in the more advanced mathematical electives, but at present it is by resident graduates of Cornell and other colleges that the best advanced work is expected to be done. Great efforts have been and are being made to secure the attendance of graduate students in advanced courses in mathematics. During the year 1885-86 eleven graduate students were engaged in the study of the higher mathematics. The number for the year following is not known to the writer, but the president's report indicates that the attendance on advanced courses in mathematics was increasing, and that about one-fifth of the graduate students were taking their chief work in mathematics. In the last report Professor Oliver says:

"During 1887-88 eleven graduate students have taken more or less of their work with us. Allowing for such as were partly in other departments or remained but part of the year, we find that the mathematical department has had about one-seventh of all the graduate work in the university. This would seem to be our full share of this desirable kind of teaching, when it is considered that the higher mathematics is difficult, abstract, and hard to popularize; that of course we can not attract students to it by laboratories and large collections (except of books), nor by the prospect of lucrative industrial applications; and that our department's whole teaching force, composed of only about one-eleventh of all the active resident professors and instructors in the university, and including only one-thirteenth of the resident professors, has to do about one-ninth of all the teaching in the university."

We are sure that many, perhaps all of our professors of mathematics will see in the following remarks by Professor Oliver the reflection of their own experience as teachers:

"We have always had to contend with one other serious difficulty. There is a wide-spread notion that mathematics is mainly important for the preliminary training of certain crude powers, and as auxiliary to certain bread-winning professions, and that only literary studies can afford that fine culture which the best minds seek for its own sake. Time, no doubt, will rectify this misapprehension; but meanwhile it hinders our success."

The methods of teaching mathematics at Cornell are various. The professors sometimes lecture, especially when there is no suitable text book at hand. This method, when a rather full syllabus is given out beforehand, and plenty of problems are assigned to the students for solution, has sometimes proved very successful. The lecturer perhaps calls upon the class for suggestions as he proceeds with his topic, and then assigns to them for home study some problem very much alike in principle to the one they have just been discussing together.

But oftener it is preferred to base the teaching upon a book that the students can study for themselves, supplementing it by lectures and explanations, and holding the class to recitations and examinations upon it *In all the work, and especially in that for advanced classes, the pupils*

are treated by the professor as fellow-students, and he avoids assuming toward them the air of master and dictator. Independent thought is constantly encouraged, even when this leads the students to criticise the things they are being taught. Mere memory-work and rote-learning—still in vogue in many of our schools—is discouraged in every way possible.

Some of the mathematical teachers at Cornell have been accustomed to test their pupil's mastery of the subject by written examinations, given in the midst of the term's work without warning, or on weekly reviews. There is also a written examination at the close of each term; but students who have done their term's work with a certain degree of excellence beyond what would be strictly requisite to "pass them up" in the subject are often exempt from this examination.

Since 1874 mathematical clubs have existed at times. Different members of it would give in turn the results of their mathematical studies in lines a little outside of the regular work of the class-room, and the matter thus presented was then open to discussion by the whole company present. Professor Oliver has generally presided at these meetings and taken his turn at presenting topics and work for discussion. The attendance upon these clubs has generally been small, including only the professors, instructors, and a few advanced students. Sometimes the meetings would be kept up for a few months or a year with a good deal of spirit, and then with change of membership the interest would flag, and the club would be discontinued for a while. Much of the work presented was the work of immature students and not worth publishing. But these clubs have helped to keep up an interest in mathematics and to stimulate the spirit of originality.

For the past three or four years the club has been merged into a "seminary" for the discussion of aims and methods in teaching mathematics. Here the professor proposes such problems as these: "Why do we teach mathematics at all, and what practical rules does this suggest to us in order that our teaching may be most effective and useful toward the end proposed?" "What is the place of memory in mathematical teaching?" "What are the relative advantages of lecturing and book work, and how are they best combined?" "How can we best teach geometry?" "What is the nature of axioms in geometry, and how modified when we consider the possibility of non Euclidian space?" The professor proposes some such problem, then calls for discussion and adds his own views. If possible he develops on the blackboard a syllabus or tabular view of the different heads under which the theory must fall. Then these are discussed in order, either at that or at subsequent meetings. In the latter case the discussions are often opened by essays from members of the seminary. This method of conducting the seminary is most fruitful of results, especially if we remember that the chief object of the graduate department in mathematics is to train teachers of this science. The coming teacher will acquire possession of better methods and higher ideals of mathematical teaching.

## VIRGINIA MILITARY INSTITUTE.

The Virginia Military Institute at Lexington, Va., is a State institution, and was organized in 1839 as a military and scientific school. It is a foster child of the U. S. Military Academy at West Point. At its organization General Francis H. Smith was made its superintendent. This position he has now held for half a century. What the Virginia Military Institute has been and is, is due chiefly to his long and faithful service as superintendent.

General Francis Henney Smith is a native of Virginia. He graduated at West Point in 1833, and was assistant professor of mathematics there during the first two years after graduation. He then occupied the chair of mathematics for two years at Hampden-Sidney College. At the military institute he added to his duties as superintendent those of professor of mathematics and moral philosophy.

Smith has published a number of mathematical text-books. Some of his books have suffered from frequent typographical errors. In 1845 appeared his American Statistical Arithmetic, in the preparation of which he was aided by R. T. W. Duke, assistant professor of mathematics at the institute. The book was called "Statistical Arithmetic," because the examples were selected as far as practicable from the most prominent facts connected with the history, geography, and statistics of our country. This novel idea made that arithmetic the medium for communicating much important information and a better appreciation of the greatness and resources of our country.

Other arithmetics appeared by the same author, which enjoyed quite an extensive circulation. About 1848 was published also a series of algebras, as a part of the mathematical series of the Virginia Military Institute.

A valuable contribution to the list of college text-books was the translation, by Professor Smith, in 1840, of Biot's Analytical Geometry. The original French work of Biot was for many years the text-book for the U. S. Military Academy at West Point. When, about ten years previous, Professor Farrar prepared his Cambridge mathematics, he chose Bezout's work on the "application of algebra to geometry," in preference to the works of Lacroix and Biot, for the reason that these works were thought to be too advanced for our American colleges, which had up to that time paid no attention whatever to *analytical* geometry. Bezout's work can hardly be called an analytical geometry. The only works on this subject which were published in this country after the Cambridge mathematics and previous to Smith's Biot were the elementary treatise of J. R. Young (which followed Bourdon as a model) and the work from the pen of Professor Davies, of West Point. Smith's translation of Biot reached a second edition in 1846. Afterward the book was revised. An edition of it appeared in 1870.

In 1867 Smith published an edition of Legendre's Geometry. Edi-

tions of this work had appeared in this country by Farrar and Davies. Smith's translation was from a later French edition, which contained additions and modifications by M. A. Blanchet, an élève of the École Polytechnique.

In 1868 appeared from the pen of General Smith a Descriptive Geometry. The study of this subject had been introduced in the institute at a time when it was hardly known by name in other schools and colleges of Virginia.

The organization of the Virginia Military Institute and the methods of teaching have been much the same as at the U. S. Military Academy. Indeed, the institute is frequently called the "Southern West Point." The division of classes into sections and the rigid and extended application of the "marking system" have been adopted from West Point. The marking system seems to have originated in France, and to have been introduced into this country by West Point.

The relative weight given to the different subjects of instruction forming the general merit-roll of each class is, according to the Official Register of 1887-88, as follows :

|                              |     |                                       |     |
|------------------------------|-----|---------------------------------------|-----|
| 1. Mathematics (grade).....  | 3   | 12. Surveying.....                    | 1   |
| 2. Civil engineering.....    | 3   | 13. Moral and political philosophy .. | 1   |
| 3. Military engineering..... | 1   | 14. Ordnance and gunnery.....         | 1   |
| 4. Chemistry.....            | 2   | 15. Drawing.....                      | 1   |
| 5. Mechanics.....            | 2   | 16. Geography.....                    | 1   |
| 6. French.....               | 1   | 17. Infantry tactics.....             | 0.5 |
| 7. German.....               | 1.5 | 18. Geology.....                      | 0.5 |
| 8. English.....              | 1   | 19. Descriptive geometry.....         | 1   |
| 9. Physics.....              | 1.5 | 20. Logic.....                        | 0.5 |
| 10. Mineralogy.....          | 1   | 21. Rhetoric.....                     | 0.5 |
| 11. Astronomy.....           | 1   | 22. Latin.....                        | 1.5 |

The success of the educational work of the school turns largely upon the method of dividing classes into *sections*, whereby the students are accurately *graded* according to scholarship, and each secures a proportionately large share of the personal attention of the instructor. Each section is "under the command of a 'section-marcher,' taken from the first cadet on the section-roll. The sections are formed on parade, at the appointed hours; the roll is called by the section-marcher, absentees are reported to the officer of the day, whose duty it is to order all not properly excused to the class duty. The section-marcher then marches his section to the class-room, reports the absentees to the professor, and then transfers to him the responsibility which he had thus far borne. The professor examines the section on the appointed lesson, is responsible for the efficiency of his instruction, and once a week makes an official report to the superintendent of the progress of his section. These reports are duly recorded, and constitute an important element in the standing of each cadet at his semi-annual or general examinations." \*

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\* The Inner Life of the Virginia Military Institute Cadet, by Francis H. Smith, LL. D., 1878, p. 22.

As at West Point, so at this institution, a candidate for admission has been required to know no other mathematical study than arithmetic. "The four ground rules of arithmetic, vulgar and decimal fractions, and the rule of three" admitted a candidate, as far as mathematics is concerned.

The course of study has been the same as at West Point, but the books used have not always been the same. The books used at the beginning were as follows: Bourdon's Algebra, Legendre's Geometry, Boucharlat's Analytical Geometry (in French), Boucharlat's Differential and Integral Calculus (in French), Davies' Descriptive Geometry. These were, later, displaced by other books, chiefly Smith's own works, viz, Smith's Algebra, Smith's Descriptive Geometry (after De Fourcy), Smith's Legendre's Geometry, Smith's Biot's Analytical Geometry, Courtenay's Differential and Integral Calculus, Buckingham's Calculus. As at West Point, so here, there have been no elective studies.

During the first twenty years of its existence the Virginia Military Institute was flourishing. It "had just placed itself before the public as a general school of applied science for the development of agricultural, mineral, commercial, manufacturing, and internal improvement interests of the State and country when the army of General Hunter destroyed its stately buildings and consigned to the flames its library of ten thousand volumes, the philosophical apparatus used for ten years by 'Stonewall' Jackson, and all its chemicals. The cadets were then transferred to Richmond, and the institution was continued in vigorous operation until the evacuation of Richmond on the 3d of April, 1865."\*

The War left sad traces on the institution, besides the destruction of its buildings, library, and apparatus. Three of its professors had been slain in battle: Stonewall Jackson, who had been professor of natural and experimental philosophy since 1850; Maj. Gen. R. E. Rodes, a graduate of the institute, and, in 1860, appointed professor of civil and military engineering; Col. S. Crutchfield, also a graduate of the institute, and, since 1858, professor of mathematics. Among the slain were also two assistant professors and two hundred of its alumni.

Notwithstanding the impoverishment of the people immediately after the War, it was decided in 1865 to re-open the institution. Without one dollar at command to offer by way of salary to the professors, the board of visitors called back all who survived, and filled the vacancies of those who had died. Work was begun with earnestness. On the 18th of October, 1865, the day designated for the resumption of academic duties, sixteen cadets responded. At the end of the academic year the number of cadets was 55. Such vitality under such discouragements prompted the legislature to restore the annuity the next winter. It was not very long before the Virginia Military Institute was restored to all its former lustre. In 1870 the buildings of the institute were restored and equipped with laboratories and instruments.

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\* Official Register, 1867-68.

The Official Register for 1887-88 gives 119 cadets in the academic school. The studies in mathematics for that year are as follows: *Fourth class—First year*: Smith's Algebra, Davies' Legendre's Geometry and Trigonometry (revised by Van Amringe), Exercises. (Recitations from 8 to 11 daily.) *Third class—Second year*: Smith's Biot's Analytical Geometry, Buckingham's Differential and Integral Calculus. (Recitations from 9 to 11 daily.) *Second class—Third year*: Mahan-Wheeler, Davies' Surveying (Van Amringe), Gillespie's Surveying, field work. (Recitation from 10 to 11.) *First class—Fourth year*: Rankine's Applied Mechanics and Rankine's Civil Engineering, lectures, and field practice.

## UNIVERSITY OF VIRGINIA.

President Jefferson devoted the golden evening of his life to the founding and building up of the University of Virginia as a nursery for the youth of his much-loved State. This greatest university of the South has from its beginning had features peculiar to itself. The entire abandonment of the class system, and the course arrangement of its studies, are its most prominent distinguishing features. From the very beginning the method of instruction has been by lectures and examinations. "Text-books are by no means discarded, but the professor is expected to enlarge, explain, and supplement the text. Every lecture is preceded by an oral examination of the class on the preceding lecture and the corresponding text. This method stimulates the professor to greater efforts, and excites and maintains the interest and attention of the students a hundred fold."<sup>\*</sup>

The university was opened for students in March, 1825. It then had eight distinct schools, but at the present time it has nineteen, "each affording an independent course under a professor, who alone is responsible for the system and methods pursued." One of the eight original schools was that of mathematics, pure and applied. The first professor of mathematics (from 1825 to 1827) was Thomas Hewett Key, of England. He was a graduate of Trinity College, Cambridge. Besides his ability as a mathematician, he possessed great classical and general attainments. He resigned his position in order to accept the professorship of Latin in the London University.

His successor was Charles Bonnycastle, of England, who, upon Mr. Key's resignation, was transferred from the chair of natural philosophy to that of mathematics, which he continued to fill until his death, in 1840. He was the son of John Bonnycastle, who was widely known in England and America for his mathematical text-books, and was educated at the Royal Military Academy at Woolwich, where his father was professor. His father's books exhibit those faults which were common to English works on mathematics in his day. It is fair to presume,

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<sup>\*</sup> Dr. Gessner Harrison, in Duyckinck's *Cyclopedia of American Literature*; Article, "University of Virginia."



however, that Charles belonged to that coterie of English mathematicians of which Herschel, Peacock, Whewell, and others were members, and which introduced the Leibnitzian notation and also the ratio definition of the trigonometric functions into Cambridge. At the University of Virginia he enjoyed the reputation of a man of great ability in mathematics and of broad general knowledge. His lighter writings indicate that he could have shone also in the fields of literature. We are happy in being able to quote the following, from Dr. James L. Cabell, professor of physiology and surgery at the University of Virginia:\*

"Though apparently an earnest and enthusiastic student of the higher mathematics, it was the constant habit of Professor Bonnycastle to make extensive and varied excursions into other fields of study, such as history, metaphysical philosophy, and general literature. I remember to have seen in his private library after his death several volumes of works on moral philosophy with copious marginal notes written by him. I recall in this connection the fact that he used to speak with emphasis and some indignation on the absurd charge that the study of mathematics tends to render its votaries insensible to the force of probable evidence, and that when strict mathematical investigation cannot be had, persons whose mental discipline has been secured by such training become either obstinately skeptical or wildly credulous. He insisted that all one-sided training had a natural tendency to narrow the intellect and that this applied to all other branches of learning and all professional pursuits as well as to mathematics. The obvious remedy lies in a liberal and broad culture. It was doubtless with a view to enforce his precepts by occasional examples that he was in the habit of delivering at the opening of each session of the university a popular lecture, the topics of which, having apparently a very remote connection with mathematical studies, were actually suggested by some recent publications in the department of general literature. These addresses were greatly admired by the crowds of young men who attended them, including, in addition to his own class, representatives from all the other departments of the university. He was also a contributor to a literary magazine published by the faculty in 1828-29. Some of his articles were stories of more than ordinary merit in this class of literary productions, and would probably have made his fortune if such magazines as Harper's, Scribner's, etc., had existed at that day with a competent development of public taste.

"The only distinct impression which I can now recall as to Professor Bonnycastle's method of teaching has reference to his attempts to indoctrinate his pupils at every stage of their studies with the philosophy and essential principles of the subject under consideration. At that time most, if not all, the usual text-books and all the school teachers gave only rules which the student was to apply. So far as the students knew, these rules might be wholly arbitrary. Professor Bonnycastle

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\* Letter to the writer, January 4, 1889.

insisted on the necessity of placing the student in a position to recognize the true significance of every principle laid down. This was done by oral lectures characterized by remarkable lucidity of statement and by a marvellous fertility of striking illustrations. These lectures were fully appreciated by the better sort of students in the advanced classes, but were thought by most of us to be thrown away upon the younger and less ambitious members of the lower classes. The general verdict of all classes of hearers ascribed to Mr. Bonnycastle genius and attainments of the highest and most varied character.\*

The text-books used by Bonnycastle in pure mathematics, in connection with his lectures, were the Arithmetic, Algebra, and Differential Calculus of Lacroix, the first two in Farrar's translation. The theory of the integral calculus was taken from Young, the examples from Peacock's Collection. In geometry he used his own work on Inductive Geometry (1834).

In pure mathematics there were in his time three classes: the "First Junior," "Second Junior," and "Senior." "Of these the First Junior begins with arithmetic; but as the student is required to have some knowledge of this subject when he enters the university, the lectures of the professor are limited to the theory, showing the method of naming numbers, the different scales of notation, and the derivation of the rules of arithmetic from the primary notion of addition; the addition, namely, of sensible objects one by one. The ideas thus acquired are appealed to at every subsequent step, and much pains are taken to exhibit the gradual development from elementary truths of the extensive science of mathematical analysis." (Catalogue for 1836.) After a thorough course in arithmetic students were well prepared for algebra. In teaching the rules for adding and subtracting, etc., they were compared with the corresponding rules in arithmetic, and the agreement and diversity were noticed and explained. The elements of geometry were taught and illustrated by models. The book on Inductive Geometry was prepared especially for the use of his students. It includes geometry, trigonometry, and analytical geometry. In the definition of the trigonometric functions the ratio system is used. "The chief result which the author hoped to secure by the proposed innovation was such an arrangement of the subject as would enable him to

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dispense with the distinctions hitherto made between the different branches of geometry, and thus permit him to treat the problems embraced under the heads of synthetic geometry, analytic geometry, and the two trigonometries, as composing one uniform doctrine, the science of Quantity and Position.<sup>90</sup>

The general plan appears to be a good one, in the main. But its execution is not satisfactory. The work covers 631 crowded pages. The form in which the subject is presented is bad. Theorems and their demonstrations are in the same kind of type, and the eye finds nothing to assist and relieve it in passing over the crowded pages of prolix explanations. Nor is the reasoning always good.<sup>†</sup>

His Inductive Geometry is, we believe, the only mathematical work which he published while he was professor at the University of Virginia.

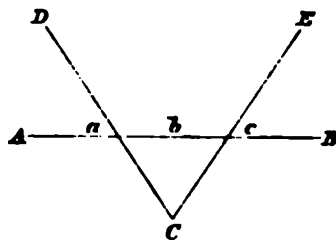
Both algebra and geometry were begun in the "First Junior" class (catalogue 1836), and then continued in the "Second Junior" class. Calculus was begun in this class and then completed in the "Senior" class.

The notation of Leibnitz was used at the University of Virginia from the very beginning.

In the Virginia Literary Museum, a weekly journal issued in 1829 by the professors of the university, we read of an examination of the

\* Preface to Inductive Geometry.

† "Angles are so evidently portions of space surrounding their vertex, and this space so manifestly the same in all cases, that we are forced to regard it, directly or indirectly, as the standard to which all angles should be referred" (p. 112). The reasoning by which the sum of the three angles of a triangle is shown to be two right



angles, is as follows (p. 123): "The lines  $AB$ ,  $CD$ ,  $CE$ , . . . that enclose a small triangle at  $C$ , are separated by the openings  $a$ ,  $b$ ,  $c$ , that are nearly equal to the angles of the triangle; two of these openings, namely,  $a$  and  $c$ , are identical with angles of the triangle, and the third,  $b$ , which forms a space indefinitely extended, differs from the opening we call the angle  $C$  merely by the small space included in the triangle.

"This last, by bringing the triangle nearer to  $C$ , may be rendered as small as we please; and thus a triangle can always be assigned whose angles shall differ from  $a$ ,  $b$ ,  $c$ , and, consequently, the sum of whose angles shall differ from two right angles by less than any assignable quantity. Some difference between the results appears, it is true, always to remain; but if we examine more attentively the idea that we are able to form of infinite space, we shall find the difference in question merely apparent, and shall perceive the sum of the three angles to be rigidly equal to two right angles." This reasoning is bad. It involves, unnecessarily, the consideration of *infinite spaces*.



Senior class in mathematics, on Thursday, July 16, 1829: "The members of the class were examined in application of algebra to geometry and the theory of curves, as contained in the IV chapter of Lacroix's *Traité du Calcul Différentiel et du Calcul Intégral*. In the differential and integral calculus they were examined by examples taken from the questions on these subjects published by Peacock & Herschel. The class have studied the differential calculus chiefly from the treatise of Boucharlat, and the integral from Boucharlat, Lacroix, and the examples before mentioned. They have proceeded to the integration of partial differential equations of three or more variables, and the questions proposed were chosen to this extent." These extracts show that the course of mathematics taught by Professor Bonnycastle was remarkably far advanced, compared with the work done in the ordinary college or university in this country at that time.

Besides the three classes above given there was from the beginning a class in mixed mathematics (really a graduate class). Under Bonnycastle the text-books in this study were Venturali's *Mechanics* and the first book of Laplace's *Mécanique Céleste*. The principles were applied to various problems. A separate diploma has been given to students completing this course of mixed mathematics.

Professor Bonnycastle left a large number of mathematical MSS. in the keeping of Professor Henry, of the Smithsonian Institution, who a short time before his death sent them to be deposited in the library of the University of Virginia.

After the death of Bonnycastle, Pike Powers, now a minister at Richmond, held the chair until J. J. Sylvester was elected professor, in 1841. Mr. Powers was a young mathematician of fine gifts and attainments, and a pupil of Bonnycastle. Professor Sylvester was then already generally recognized as a man of brilliant genius and profound mathematical learning. He resigned in about half a year, and afterward accepted a professorship in the Royal Military Academy at Woolwich. We shall have to say more about him in connection with the Johns Hopkins University. Prof. Pike Powers was again appointed, temporarily, to teach the mathematics.

The next possessor of the mathematical chair was Edward H. Courtenay, from 1842 to 1853. He was the first regular occupant of this chair who was educated in this country. He was born in Baltimore, in 1803. After having been examined for admission to the U. S. Military Academy at West Point, in 1818, the examiner remarked: "A boy from Baltimore, of spare frame, light complexion, and light hair, would certainly take the first place in his class." Courtenay completed the four years' course in three years, and graduated at the head of his class in 1821. From that time till 1834 he was connected as teacher with the Military Academy, excepting the period from 1824 to 1828. After leaving West Point he was for two years professor of mathematics at the University of Pennsylvania, then he became division engineer for the



New York and Erie Railroad. He was employed by the United States Government as civil engineer in the construction of Fort Independence, Boston Harbor, from 1837 to 1841. Just before his appointment to the professorship at the University of Virginia he was chief engineer of dry-dock, Navy-Yard, Brooklyn, N. Y.\*

Mr. Courtenay was a mathematician of noble gifts and a great teacher. "His mind was quick, clear, accurate, and discriminating in its apprehensions, rapid and certain in its reasoning processes, and far-reaching and profound in its general views. It was admirably adapted both to acquire and use knowledge."<sup>†</sup> He was modest and unassuming in his manner, even to diffidence. He would never utter a harsh word to pupils or disparage their efforts. "His pleasant smile and kind voice, when he would say, 'Is that answer *perfectly* correct?' gave hope to many minds struggling with the difficulties of science, and have left the impression of affectionate recollection on many hearts."<sup>‡</sup>

Regarding his work at the University of Virginia, Professor Venable (at one time a pupil of Courtenay) says that his course in pure mathematics was prepared and written out (or rather printed on white cloth in large letters) with great care—following Bonnycastle in the use of Young in the treatment of the differential and integral calculus. His course in this branch embraced differential equations and the calculus of variations. His MSS. on these two subjects for the Senior class fill nearly one hundred and fifty pages of his printed work. His notes on the calculus were published in 1857, after his death, and became a valued text book in many institutions. "In its publication the plan, language, and even the punctuation have been followed with a fidelity due to the memory of a friend." The work was more extensive than any which had yet appeared in this country on the same subject. Courtenay added descriptive geometry to the regular course of pure mathematics. He prepared extensive notes for his class in mixed mathematics, which embraced a full course in the applications of the calculus to mechanics and to the planetary and lunar theories (perturbations).

In 1845 the course in the School of Mathematics was as follows: *Junior class*, theory of arithmetic, algebra, synthetic geometry; *Intermediate class*, plane and spherical trigonometry, land surveying, navigation, descriptive geometry and its application to spherical projection, shadows, perspective; *Senior class*, analytical geometry, calculus. The class in mixed mathematics studied selections from Poisson, Francœur, Pontécoulant, and others. This embraced the mathematical investigations of general laws of equilibrium and motion, both of solids and fluids. The text-books for that year were, Lacroix's Arithmetic, Davies' Boardman, Legendre's Geometry, Davies' Surveying and Descriptive Geometry, Davies' Analytical Geometry, Young's Differential and Integral Calculus.

\* Courtenay's *Life*, p. iv.

<sup>†</sup> *Ibid.*, p. v.

<sup>‡</sup> *Ibid.*, p. vii.

After the death of Courtenay the chair of mathematics was filled by Albert Taylor Bledsoe. He was a native of Kentucky, and graduated at West Point in 1830. He was one year adjunct professor of mathematics and French at Kenyon College, Ohio; then one year professor of mathematics at Miami University, Ohio. Afterward he practiced law for eight years at Springfield, Ill. Before his coming to the University of Virginia he was professor of mathematics and astronomy at the University of Mississippi. He remained in his new position till 1863, then became assistant secretary of war in the Southern Confederacy. After the War he became principal of a female academy in Baltimore and editor of the *Southern Review*. He died in 1877 at Alexandria, Va.

- Prof. Francis H. Smith, of the University of Virginia, who was associated with Bledsoe in the faculty of the institution, writes us about him as follows: "He succeeded here an eminent teacher, Prof. Edward H. Courtenay; and, while the two men were most unlike in every respect, Dr. Bledsoe's evident ability so impressed his class, that the prestige of the mathematical class suffered no loss in his hands. From his lifelong addiction to metaphysical studies, he entered with great zeal upon the philosophy of mathematics, a subject which every infantile mathematician is bound to have an attack of, but which in its widest relations may very well tax the powers of the most mature and advanced geometer. In this field I think Dr. Bledsoe won a place by the side of Bishop Berkeley and Auguste Comte. His treatise on the Philosophy of Mathematics was put in print and had a considerable circulation. He established a new course of lectures here in connection with the usual mathematical curriculum, upon the History and Philosophy of Mathematics. That feature survives to this day. As a manipulator of mathematical formulae and solver of mathematical problems, Dr. Bledsoe was not strikingly able. I have known many men of far less strength who were his superiors in mere algebraic dexterity. Yet, I was convinced from several incidents which came to my knowledge during his teaching here that had his life, after he left West Point, been devoted to the science, he would have left the pure mathematics simplified in statement and improved in form. His originality and force were obvious to me, to whom he freely communicated his difficulties and successes, during his entire residence here. I learned that while at the Military Academy these traits were strikingly exhibited by his solving a problem in the tangencies of circles which had up to that time baffled the geometrical skill of the academy, and which had been left unsolved by Archimedes himself. The solution given by Dr. Bledsoe was afterward published in the *Southern Review*, of which the doctor was editor and proprietor for a number of years before his death. He had in the latter years of his life completed a treatise on synthetical geometry, of the Euclidian type, and, I think, had found a publisher, but whether it ever got printed I am not aware. Dr. Bledsoe's greatest work was in the field of metaphysical theology, constitutional law, and review articles."

His *Philosophy of Mathematics*, published in 1867, exhibits brilliant controversial powers. It initiated a reactionary movement among us against the unphilosophical exposition of the calculus in the colleges of our land. The book is somewhat verbose in its style. The bulk of it consists of criticisms of various text-books. Comparatively little space is given to what the author considers to be the true explanation of the subject. It seems to us that the criticisms which he makes are generally good and well founded, but that he fails in proposing a sound substitute for the explanations which he rejects. The influence of the book has been beneficial in so far as it has caused many teachers to meditate upon the philosophy of the calculus.

He gave lectures also on the history of mathematics—a subject which received little or no attention in our colleges at that time. He prepared, but never published, a work on analytical geometry, in which, by the discussion of one equation which contained, wrapped up within itself, the whole folio of Apollonius on conic sections, he developed the properties of the circle, ellipse, hyperbola, and parabola.\*

Bledsoe pursued, in the main, the course in pure mathematics laid down by his predecessor, except that Courtenay's *Calculus* was used in place of Young's. For the class in mixed mathematics he used (in 1854) Bartlett's *Analytical Mechanics*, Newton's *Principia*, and Pratt's *Mechanical Philosophy*. Pontecoulant's *Système du Monde* was also used by him for his class.

Professor Bledsoe was not very strict with students in their daily work, but on approach of examination day he knew how to prepare a tough set of questions.

By temporary appointment, Alexander L. Nelson taught mathematics during part of the session 1853-54; Robert T. Massie during part of the session 1861-62, and Francis H. Smith, of the School of Natural Philosophy, from 1863 to 1865.

During the War the university barely subsisted; but scarcely was peace restored ere the institution, amidst perplexing pecuniary embarrassments, prepared with resolute energy to enlarge its capacity for useful work by multiplying its schools. In 1867 the School of Applied Mathematics with reference to Engineering was established.

In 1865 Charles S. Venable was appointed to the chair of mathematics, a position which he still occupies. He is a native of Virginia, and was born in 1827. After graduating at Hampden-Sidney College in 1842, he remained one year at the college as a resident graduate, pursuing mathematics under Col. B. L. Ewell (a West Point graduate, and afterward president of William and Mary College), and English literature and history under Maxwell. He then became tutor in mathematics, in which capacity he continued two years, devoting part of his time to the study of law. In 1845, he went to the University of Virginia and spent one session in the study of law, mathematics, and lan-

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\* Bledsoe's *Philosophy of Mathematics*, p. 130.

guages. Here he took the mathematical lectures of Professor Courtenay. He was then elected professor of mathematics at Hampden-Sidney College, to succeed Ewell. After remaining there one year he obtained leave of absence, returned to the University of Virginia, and studied mixed mathematics and engineering under Professor Courtenay. He returned to Hampden-Sidney in 1848, and filled the chair of mathematics till June, 1852. He then obtained leave of absence again, and visited Germany for the further prosecution of studies. In Berlin he studied astronomy under Encke, and mathematics with Dirichlet and Borchardt. He then went to Bonn, studying some months under Professor Argelander, the director of the observatory of Bonn. While in Germany astronomy was his chief branch of study. He then travelled in Southern Europe, studied for some time in Paris, visited England, and then returned to Hampden-Sidney College, in 1853. In 1856 he was elected to the chair of natural philosophy and chemistry at the University of Georgia, to succeed John Le Conte, and in 1857, professor of mathematics and astronomy in the South Carolina College. In 1858 he published an edition of Bourdon's Arithmetic. Venable took part in the attack upon Fort Sumter, and took active part in the War until its close.\* Since his connection with the University of Virginia, Professor Venable has issued a series of text-books, consisting of *First Lessons in Numbers*, 1866, revised in 1870; *Mental Arithmetic*, 1866; *Practical Arithmetic*, 1867, revised in 1871; *Intermediate Arithmetic*, 1872; *Elements of Algebra*, 1869; *Elements of Geometry*, 1875; *Notes on (analytical) Solid Geometry*.

These rank among the best and most rigorously scientific school-books published in this country. In his arithmetics, the attempt is made "to render the reasoning of such arithmetics as those of Bourdon, Briot, DeMorgan, and Wrigley, easily accessible to the young." His *Elements of Geometry* is "after Legendre," but it differs from the original in the discussion of parallels, in the use of the methods of limits instead of the method of the *reductio ad absurdum*, in the fuller treatment of certain parts of the subject, and in giving, at the beginning, a chapter on the Theory of Proportion (in which the theory of limits is used for incommensurables) instead of presupposing a knowledge of proportion, as is done by Legendre. One feature is carried out in this geometry more extensively than in any other of our books, namely, the insertion of "hints to solutions of exercises." A teacher who does not make his pupils solve original problems in geometry, is a failure. But the exercises given in most books are not sufficiently graded, and the young beginner is very apt to get discouraged. The "hints" given in this book serve the excellent purpose of assisting and encouraging the pupil in his first attempts at original work. In 1887 Professor Venable published an *Introduction to Modern Geometry*, which serves as an

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\*Our sketch of the early career of Professor Venable is taken from *La Borde's History of South Carolina College*, 1874, p. 474.

appendix to his geometry. The treatment of the subject is metrical rather than descriptive.

The method of instruction under Professor Venable has been essentially the same as that followed by his predecessors. It consists of lectures, predilections on approved text-books, and exercises for testing and developing the power of the student in original solutions. Great stress is constantly laid on the solution by the student of original exercises. In this respect, each meeting of the class is a seminarium. In delivering their lectures, some professors of the university write condensed notes on the blackboard, others give syllabuses. The students very soon get up printed or lithographed notes on the lectures. The practice of reading the lectures does not prevail at the university.

One might suppose that in an institution where students have the privilege of attending whatever school they please, the enrollment in the school of mathematics would be comparatively small. This has, however, not been the case here. The attendance on this school is, as a rule, greater than on any other school of the academic department. In three or four sessions, since the War, the number of students in the school of Latin has been greater, but by not more than half a dozen students. The full attendance is in itself good evidence of the careful teaching and efficient work in the mathematical department. In order to present a fuller picture of the services of Professor Venable, we quote from a letter of R. H. Jesse, professor of Latin at the Tulane University of Louisiana, and a former student of the University of Virginia. "In my day Colonel Venable was absolutely the most popular among the students of all the professors in the University of Virginia. At the same time his control was perfect over all his classes, and indeed over any and all bodies of students with whom he came in contact. Doubtless his experience as an officer of rank in the Confederate service, his long practice in teaching, and his never failing kindness of heart and sympathy with young men, produced both the popularity and the power of control.

"Ever since I have known the institution well, now nearly twenty years, he has been, more than any other man, active and able in promoting her best interests. To him in large degree was due the increase by the State, in 1875 or 1876, of her annual contribution from fifteen thousand dollars to thirty thousand dollars. This increase was accompanied with the condition that all Virginia students able to pass the entrance examinations to the academical schools should be educated in those schools free of charge. To him chiefly was due the raising of the endowment fund whereby the McCormick telescope was gained for the university. To him chiefly has been due the large increase in attendance upon the university in late years. Twice he has been Chairman [of the faculty] and twice has he laid the office down voluntarily, when the university, guided safely by his wisdom and energy through some serious difficulties, had reached excellent condition again. He has had,

to my certain knowledge, many flattering calls to other fields, far more profitable in money, but he has immediately declined them all to stand fast by his *alma mater*."

The high and rigid standard inaugurated by Bonnycastle and Courtenay has been rigorously adhered to. The standard of graduation has always been high, in fact, very high in comparison with the standards in most other American colleges. The mathematical course has been broadened, as the preparation of students under the influence of the university upon the academies and colleges has become broader and better. "We have many excellent preparatory schools in Virginia," says Professor Venable, "which prepare students well, far into the differential and integral calculus in such works as Todhunter's and Courtenay's Calculus."

The course in mathematics, as stated in the catalogue for 1887-88, is as follows:

#### I. PURE MATHEMATICS.

**JUNIOR CLASS.**—This class meets three times a week (4½ hours) and studies theory of arithmetical notations and operations; algebra, through the binomial theorem; geometry, plane and solid; geometrical analysis, with numerous exercises for original solution; elementary plane trigonometry, embracing the solution of triangles, with the use of logarithms, and some applications to problems of "heights and distances." The preparation desirable for it is a good knowledge of arithmetic, of algebraic operations through equations of the second degree, and of the first three books of plane geometry.

*Text books.*—Todhunter's Algebra; Venable's Legendre's Geometry, with collection of exercises; Todhunter's Trigonometry for Beginners.

**INTERMEDIATE CLASS.**—This class meets twice a week (3 hours) and studies geometrical analysis, with exercises for original solution; plane trigonometry, with applications; analytical geometry of two dimensions; spherical trigonometry, with applications; elements of the theory of equations. The preparation desirable for this class is a thorough knowledge of algebra through the binomial theorem, and logarithms; of synthetic geometry, plane and solid, with some training in the solution of geometrical problems; and a knowledge of the elements of plane trigonometry, including the use of logarithmic tables.

*Text books.*—Snowball's Trigonometry, Puckle's Conic Sections, the Professor's Collection of Exercises in Plane Geometry.

**SENIOR CLASS.**—This class meets three times a week (4½ hours) and studies analytical geometry of three dimensions, through the discussion of the conicoids and some curves in space; differential and integral calculus, with various applications; a short course in the calculus of variations; the theory of equations, and lectures on the history of mathematics.

*Text books.*—The Professor's Notes on Solid Geometry (Analytical); Todhunter's Differential Calculus; Williamson's Integral Calculus; Todhunter's Theory of Equations.

Candidates for graduation in pure mathematics are required to pursue in the university the studies of both the Intermediate and Senior Classes.

#### II. MIXED MATHEMATICS.

This course is designed for those students who may desire to prosecute their studies beyond the limits of pure mathematics. It embraces an extended course of

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\*In former years Professor Venable used Courtenay's Integral Calculus, which was supplemented with notes which "nearly equalled the text." (Prof. R. H. Jesse.)

reading under the instruction and guidance of the professor on the applications of the differential and integral calculus to mechanics, physical astronomy, and selected portions of physics. The class in mixed mathematics meets twice a week (3 hours).

*Text-books:* *Principles of Natural Calculus*, Vols. II and III; Cheyne's *Planetary Theory*.

Mathematical physics and spherical astronomy are taught in the school of natural philosophy, in charge of Prof. F. H. Smith. Norton's *Astronomy* is one of the text-books. In this school, under practical physics, are studied also the method of least squares.

In addition to the under graduate course in mathematics there is now a more extended course, occupying a large part of two sessions of nine months. It is given to graduates who are candidates for the degree of doctor of philosophy in the mathematical sciences. This course includes, in addition to the course in mixed mathematics, the study of modern higher algebra, modern higher geometry (Steiner's or some like work), a fuller study of the differential and integral calculus (Price and Hoüel), determinants (taught at the university for the last fifteen years), a fuller course in differential equations, probabilities, and other selections. If the candidate chooses astronomy for his secondary branch, then he studies Gauss's *Theoria Motus*, and enters into the practical computation of orbits. Should he choose physics, then he studies some of the advanced treatises in the line of mathematical physics.

In order to give a better idea of the course leading to the degree of doctor of philosophy, we quote from a letter of Dr. S. M. Barton:

"This doctorate course consisted of graduate studies in pure and mixed mathematics and mathematical and practical astronomy, and the text-books read, and on which I was examined, were as follows: Hoüel's *Calculus*, Vol. I, 2d. ed., 6 or volumes; Gauss's *Traité de Géométrie Supérieure*; Price's *Principles of Natural Calculus*, Vol. III; Statics and Dynamics of Material Particles; Cheyne's *Planetary Theory*; Abhis's *Rigid Dynamics*; Notes and Examples selected by the Professor.

"The above were required in the mathematical department. In astronomical text-books and requirements were: Gauss's *Theoria Motus*; Notes on the Computation of Orbits, by Prof. Ormond Stone; Notes on Least Squares, Perturbations, Variations of Constants, etc., by Professor Stone; Computation of the Orbit of Barbara No. 271. This last was of course a work of several months.

"I was allowed to select my own subject for a thesis, which was accepted by the faculty and read before I stood my last examinations.

"The preparation for this thesis I was obliged to read, outside of the studies and lessons in the course, the method of equipollences, and the method of the minimum, and I various articles bearing on the subject, and the following works: *Exposition de la Méthode des Equipollences*, by Beltrami, translated into French by P. Mansion; *Leçons de Géométrie Supérieure*, etc., by Mourey. Articles on the subject in *Math. Annalen*, Kelland and Tait's *Introductory Quaternions*, Tait's *Quaternions*.

"In pursuing these doctorate studies I, of course, made use of many books for reference, among which I might mention Salmon's Conic Sections and Higher Plane Curves, and Geometry of Three Dimensions. Gregory's Examples. Vols. I and II of Price's Calculus. Some older works by Peacock and others, as well as some more elementary treatises. . . .

"I can not refrain . . . from alluding to one striking feature of the mathematical teaching at the University of Virginia, namely, independence in the student; and by independence I mean the *spirit of self-reliance* which enables the student to work out and elucidate for himself.

"The student is taught from the start to depend upon himself.

"This spirit of self-reliance pervades the mathematical department, and it promotes originality, as well as gives zest to the work.

"This would seem to be the only true way to teach mathematics, but many of our elementary teachers do little or nothing to inculcate this great principle."

The thesis referred to above is entitled "Bellavitis's Method of Equipollences" (1885). It contains an outline of the calculus of equipollences and of its relation to quaternions. It shows that while equipollences are more readily mastered, and yield on the whole more expeditious solutions of plane problems than quaternions, the latter are immeasurably superior in elegance, logical simplicity, and extent of application.

Since Professor Venable has been connected with the University of Virginia, the department of mathematics has graduated many students who have become prominent as teachers and scientists in their specialty. Chief among these are Prof. C. E. Vawter, professor of mathematics in Emory and Henry College for some years, now in charge of the Miller Manual Training School; Prof. G. Lanza, professor of mathematics at the Massachusetts Institute of Technology; Prof. W. M. Thornton, of the school of applied mathematics, University of Virginia; Professor Graves, professor of mathematics at the University of North Carolina; Professor Gore, professor of physics and astronomy at the University of North Carolina; Professor Bohannon, professor of mathematics at the University of Ohio (Columbus); Prof. H. A. Strode, principal of Keumore University High School, Virginia; Prof. W. H. Echols, professor of engineering and president of the school of mines at the University of Missouri; Prof. W. H. Richauser, professor of mathematics at the school of mines, University of Missouri; Prof. T. U. Taylor, assistant professor of mathematics, University of Texas.

Applied mathematics, i. e., mathematics applied to civil engineering, was taught in the school of mathematics almost at the beginning of the university. In 1832 a class in engineering was organized as a separate department under the professor of mathematics, and was maintained as an attachment to the school of mathematics until 1850. It was then left out of the catalogue from the fact, no doubt, that the successful



working of such a course imposed too heavy a burden upon the mathematical professor. In 1865 the department of civil engineering was revived and placed under the joint charge of the professors of mathematics, physics and chemistry. In 1867 Prof. Leopold J. Boeck was made assistant professor and placed in charge of the school of applied mathematics, comprising courses in civil and mining engineering. These led to the degrees of civil and mining engineer, respectively. In 1868 Professor Boeck was promoted to the full professorship of applied mathematics. He held the chair until 1875, when he resigned, and was succeeded by Wm. M. Thornton, as assistant professor. Professor Thornton was subsequently promoted to the full professorship of applied mathematics. This school has sent out a large number of engineers of sound training.

Mention should be made here of the school of practical astronomy, under the direction of Prof. Ormond Stone. He is also director of the McCormick Observatory, and editor of the *Annals of Mathematics*.

#### UNIVERSITY OF NORTH CAROLINA.\*

Professor Mitchell's successor in the chair of mathematics was James Phillips, from 1826 to 1867. Professor Love speaks of him as follows: "He was born in England in 1792. It is not known at what school he received his early education. The greater portion of his mathematical education was gotten by private study. He came to America in 1818 and opened an academy in Harlem, N. Y. Here he won reputation as an instructor, and by contributions to the mathematical publications of the day. In 1826 he came to North Carolina as professor of mathematics and natural philosophy.

"He was a patient student of the masters in mathematics, of Ferguson, Newton, Delambre, Laplace, and others. He prepared a text-book on conic sections which was published and used as an introduction to analytic geometry. He left in manuscript the greater portion of a series of text-books on mathematics, including the calculus. These were most carefully prepared, but for some reason he never published any of them. Probably the War was the cause of his not publishing. He left directions when he died that all his MSS. should be burned. Among them were also many translations from French mathematical works.

"That Dr. Phillips never published more is very much to be regretted. He had great mathematical ability, and was an extremely careful and lucid writer. Like Dr. Mitchell, he divided his time and energy. Both of them were ministers and spent much time in the preparation of sermons. Dr. Phillips left hundreds of manuscript sermons; and these he directed to be burned with all his other MSS. He died suddenly of

\* For all the information here given on the University of North Carolina, the writer is indebted to Prof. James L. Love, associate professor of mathematics at the university.

apoplexy in the college chapel, where he had gone to conduct morning prayers, on the 14th of March, 1867."

The requirements for admission were raised in 1835 so as to include all of arithmetic. It seems that in the same year a little of algebra—"Young's Algebra to simple equations"—was also required. The increase in the requisites for entering college were brought on at this time with excessive haste, and we are not surprised that, after three years' trial, algebra was withdrawn. It was not again required until 1855, when candidates were examined on "algebra through equations of the first degree." No alterations were made till 1868.

As regards the courses of study, Professor Love says: "In 1835 arithmetic was dropped, algebra was completed in the Freshman year, and conic sections and analytic geometry begun in the Sophomore year. In 1839 mechanics was introduced into the Sophomore and Junior years, civil engineering into the Senior year, and since that date analytic geometry has been completed in the Sophomore year. Calculus was begun in the Sophomore year in 1841, and from that date to 1868 it was sometimes in the Sophomore year and sometimes in the Junior year. For fifty years, from 1818 to 1868, first fluxions and then differential and integral calculus were required of all graduates. A three-years' course in engineering was introduced in 1854. It included in addition to the regular course required for graduation, descriptive geometry, drawing, shades and shadows, mechanics, civil engineering, and geodesy. This course was continued until 1862.

"An attempt was made in 1855 to offer some election of courses in the Sophomore and Junior years. Two courses were offered, the one analytical, the other geometrical. The latter embraced geometry, plane and spherical trigonometry, mensuration, surveying, navigation, natural philosophy, and astronomy. The analytical course included, in addition, analytical geometry, differential and integral calculus, statics and dynamics, acoustics and optics. During the Freshman year the two courses were identical, but for the Sophomore and Junior years different text-books were used, even for the same subjects, in the two courses. After two years' trial, these double courses were given up. From 1857 to 1868 the one mathematical course was as follows: *Freshman year*, algebra, geometry; *Sophomore year*, plane and spherical trigonometry with applications, analytical geometry, differential and integral calculus; *Junior year*, natural philosophy and astronomy."

Our list of books used by Professor Phillips is quite complete; Ryan's Algebra was used in 1827; Young's Algebra was introduced in 1836; Peirce's was studied from 1844 to 1868. In geometry, Legendre was used for a time. About 1843 Peirce's Geometry was introduced, and not dropped till 1868, except for the years 1855 to 1857, when Perkins and Loomis were used each one year. From 1857 to 1868, Munroe's "Geometry and Science of Form" was used in the Freshman class as an introduction to geometry. The idea of premising a course in demon-

strative geometry by a short one in empirical geometry is very commendable. In descriptive geometry, Davies' was introduced in 1854; also his *Shades and Shadows*. In 1844 Peirce's trigonometry was introduced; Perkins's was used from 1855 to 1856; Charles Phillips's from 1856 to 1860; Loomis's from 1860 to 1868. In conic sections James Phillips's was taught from 1830 to 1847, when Peirce's book was introduced. From 1851 to 1868 Loomis's was studied, except from 1853 to 1855, when Church's and Smith's Biot's were used, each a year.

In calculus the notation of Leibnitz was introduced in 1830. Hutton's work was supplanted in 1847 by Peirce's *Curves, Functions, and Forces*, which was followed in 1851 by Loomis's. This was used until 1868, except in 1853, when Church's was taught for one year. In astronomy, Peirce's book was introduced in 1847, Herschel's in 1853, and Norton's in 1857.

Before the Civil War the university was prosperous and popular. The courses in mathematics described above were certainly very creditable for their day. Hon. Wm. H. Battle spoke of the university as follows: "In the extent and variety of its studies, the number and ability of its instructors, and the number of its students, it surpassed nearly all similar institutions in our own section of the country, and was beginning to rival the old, time honored establishments of Yale and Harvard. In the year 1858 its catalogue showed a larger number of undergraduates than that of any other college in the United States, except Yale. All this success was accomplished in a very short time. A glance at the rapidly increasing ratio of its graduates will illustrate the truth of my remark. For the first ten years after the date in which degrees were conferred by the university, the number of students who received the baccalaureate was 53; for the second decade it was 110; for the third, 259; for the fourth, 116; for the fifth, 308; for the sixth, 418; and for the seventh the annual number was going on at a rate which would have produced 882, nearly the double of that which immediately preceded it."\*

During the Civil War nearly all Southern colleges closed their doors, but not so the University of North Carolina. It was the boast of its president that during the four years of war the college bell never failed in its daily calls, that the faculty was ever in place for duty, and that all grew "strong on dum and corn bread;" that the institution was "never out of order." The severest blow to the prosperity of the university came after the War. In 1868 the old faculty was supplanted by the "reconstructed" State government, and from 1868 to 1871 the new faculty labored to make the university popular again. Its popular teaching was too light; the university was closed from 1871 to 1876.

\*A. S. Johnston, *History of the University of North Carolina*, 1894, pp. 14-15. See also Hon. Wm. H. Battle.

Charles Phillips became professor of mathematics in 1875. He had been tutor from 1844 to 1853, associate professor from 1855 to 1860, and professor of engineering from 1853 to 1860. In 1879 he was made professor emeritus of mathematics, and Ralph H. Graves, jr., who had been professor of engineering since 1875, became now professor of mathematics. Professor Graves is a graduate of the University of Virginia and a former pupil of Professor Venable. Since 1885 James Lee Love has been associate professor of mathematics. He graduated at the university at the head of his class, and then took a graduate course in mathematics at the Johns Hopkins University in the year 1884-85.

Under the present able corps of instructors, mathematical teaching is again flourishing. Since the re-opening, in 1875, the requirements in mathematics for admission have been : arithmetic, and algebra to quadratic equations. The course in mathematics has been as follows : *Freshmen*, algebra, geometry ; *Sophmores*, plane and spherical trigonometry, logarithms, plane analytical geometry ; *Juniors*, theory of equations, differential and integral calculus, natural philosophy ; *Seniors*, mechanics, astronomy. The studies of the first and second years have been required of all graduates. The studies of the third year, except natural philosophy, have been elective. Mechanics and astronomy were required in all courses leading to degrees until 1885. Since that time mechanics is elective in all courses, and astronomy elective in the A. B. course. Since 1885 post-graduate electives have been offered in solid analytic geometry (Smith's), determinants, differential equations, modern algebra, and quaternions. From 1875 to 1879 a three-year course in engineering was offered. Since 1879 the course has been partially withdrawn ; and at present (1888) it includes only a one-year course in surveying, descriptive geometry, and projective drawing.

Robinson's University Algebra was used from 1869 to 1871, and since 1875 Schuyler's, Venable's, Newcomb's, and Well's—Newcomb's most. In geometry the books have been, since 1875, those of Venable, Wentworth, Newcomb, and J. W. Wilson. In descriptive geometry and projective drawing Warren's is taught. Davies' Trigonometry was used from 1869 to 1871, Wheeler's since 1875, and Newcomb's since 1882. In calculus the works of Peck, Courtenay, Bowser, Byerly, and Todhunter have been in use. Since 1883 Williamson has been the textbook. Newcomb and Deschanel are the books in astronomy and physics.

In 1883 the Elisha Mitchell Scientific Society was organized. The professors of mathematics take part in its exercises. Meetings are held once each month for the presentation of papers on any scientific subject. The society publishes a Journal, with abstracts of the more important papers read, and the writer has before him Vol. V, Part I, in which appear two papers by Professor Graves on geometrical subjects. These have been published also in the *Annals of Mathematics*, to which Professor Graves is a frequent contributor.

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<sup>1</sup> A. S. Johnston, *History of the University of North Carolina*, pp. 112-113. Quoted by Hon. Wm. H. Battle.

Charles Phillips became professor of mathematics in 1875. He had been tutor from 1844 to 1853, associate professor from 1855 to 1860, and professor of engineering from 1853 to 1860. In 1879 he was made professor emeritus of mathematics, and Ralph H. Graves, jr., who had been professor of engineering since 1875, became now professor of mathematics. Professor Graves is a graduate of the University of Virginia and a former pupil of Professor Venable. Since 1885 James Lee Love has been associate professor of mathematics. He graduated at the university at the head of his class, and then took a graduate course in mathematics at the Johns Hopkins University in the year 1884-85.

Under the present able corps of instructors, mathematical teaching is again flourishing. Since the re-opening, in 1875, the requirements in mathematics for admission have been: arithmetic, and algebra to quadratic equations. The course in mathematics has been as follows: *Freshmen*, algebra, geometry; *Sophmores*, plane and spherical trigonometry, logarithms, plane analytical geometry; *Juniors*, theory of equations, differential and integral calculus, natural philosophy; *Seniors*, mechanics, astronomy. The studies of the first and second years have been required of all graduates. The studies of the third year, except natural philosophy, have been elective. Mechanics and astronomy were required in all courses leading to degrees until 1885. Since that time mechanics is elective in all courses, and astronomy elective in the A. B. course. Since 1885 post-graduate electives have been offered in solid analytic geometry (Smith's), determinants, differential equations, modern algebra, and quaternions. From 1875 to 1879 a three-year course in engineering was offered. Since 1879 the course has been partially withdrawn; and at present (1888) it includes only a one-year course in surveying, descriptive geometry, and projective drawing.

Robinson's University Algebra was used from 1869 to 1871, and since 1875 Schuyler's, Venable's, Newcomb's, and Well's—Newcomb's most. In geometry the books have been, since 1875, those of Venable, Wentworth, Newcomb, and J. W. Wilson. In descriptive geometry and projective drawing Warren's is taught. Davies' Trigonometry was used from 1869 to 1871, Wheeler's since 1875, and Newcomb's since 1882. In calculus the works of Peck, Courtenay, Bowser, Byerly, and Todhunter have been in use. Since 1883 Williamson has been the textbook. Newcomb and Deschanel are the books in astronomy and physics.

In 1883 the Elisha Mitchell Scientific Society was organized. The professors of mathematics take part in its exercises. Meetings are held once each month for the presentation of papers on any scientific subject. The society publishes a Journal, with abstracts of the more important papers read, and the writer has before him Vol. V, Part I, in which appear two papers by Professor Graves on geometrical subjects. These have been published also in the *Annals of Mathematics*, to which Professor Graves is a frequent contributor.

to success in all classes of the college, applicants must be prepared for a full and searching examination in this study."

In 1836 the course of study was as follows:

**"Freshman year:** Bourdon's Algebra to equations of the third degree, ratios and proportions, summation of infinite series, nature and construction of logarithms, Legendre's plane geometry. **Sophomore year:** Legendre's solid geometry, constructions of determinate geometrical equations, Davies' mensuration and surveying, including methods of plotting and calculating surveys, measurement of heights and distances, and use of instruments in surveying. **Junior year:** Descriptive geometry and conic sections, principles of perspective, analytic geometry, fluxions—direct and inverse methods in their application to maxima, minima, quadrature, cubature, etc. **Senior year:** Natural philosophy and astronomy.

"There shall be daily recitations of each class, one after morning prayers, one at 11 A. M., one at 4 P. M. On Saturday morning there shall be one recitation."

In the introduction of descriptive geometry into the course, we notice West Point influences. The "fluxions" above mentioned must mean "differential and integral calculus." Mr. Twiss, the professor at this time, was a graduate of the Military Academy at West Point, and was not likely to teach fluxions and the Newtonian notation.

In 1838 the Freshmen finished the whole, both of algebra and geometry; the Sophomores had plane and spherical trigonometry in place of solid geometry.

In 1841 Davies' Calculus was studied in the Junior year. Three years later, the Sophomores were taught from Davies' works on Mensuration and Surveying, Analytical Geometry, and Descriptive Geometry. In 1848 (M. J. Williams, professor) Loomis's Conic Sections were studied. Descriptive geometry and calculus were taught by lectures. After completing the calculus, in the Junior year, Olmsted's Mechanical Philosophy was taken up. The Seniors had courses in astronomy and (Mahan's) civil engineering. Owing to a rise in the terms for admission Bourdon's algebra was omitted in the first year, the studies for the other classes remaining the same. In 1854 descriptive geometry was thrown out of the course. Professor McClay was not a West Point graduate, and attached, probably, less importance to this branch. In 1857 spherical geometry was transferred from the second to the third year.

In 1858 the Freshmen studied geometry (Legendre), reviewed algebra (applications of algebra to geometry); the Sophomores, mensuration, surveying and leveling, conic sections (Loomis), mechanics (gravity, laws of motion); the Juniors had lectures on calculus, spherical trigonometry, mechanical philosophy (Olmsted); the Seniors, astronomy, civil engineering, natural philosophy (Olmsted).

In 1860 Professor Venable introduced at the end of the first year theoretical arithmetic, using his own edition of Bourdon. He used also

Loomis's Geometry in place of Legendre. In 1861 Loomis's Geometry is mentioned, "with original problems." Algebra was reviewed and applied to "geometrical problems." We judge that extra efforts were made by Professor Venable to improve on the traditional methods of teaching, by requiring the student to do a great deal of original work in the line of solving problems.

In 1863 the buildings of the college "were taken possession of by the Confederate Government, and used as a hospital until the close of the War." Its charter was amended by the Legislature in 1865, and in the following year it was re-opened as the University of South Carolina.

The mathematical chair was given to E. P. Alexander, a graduate of West Point and a man of great ability. During the War he was a Confederate brigadier, distinguished himself at Gettysburg, and introduced "signalling" into the Confederate army. As a teacher he was much liked. He was very practical and to the point in his methods and illustrations. Since leaving the college, he has been connected with railroads, either as president or otherwise.

Prof. T. E. Hart, a graduate of Heidelberg, taught mathematics from 1870 to 1872. He was then and is now in very poor health, suffering from paralysis. While he was professor his classes had often to go to his house for recitation.

From 1873 to 1876 A. W. Cummings held the mathematical chair. At this time the college passed through the darkest period of its history. These were the unfortunate years of "reconstruction." In addition to the numerous obstacles which American colleges generally have had to encounter, the colleges in the South have had to contend with great political upheavals. Like the University of North Carolina, the University of South Carolina closed its doors. From 1876 to 1880 the institution was without faculty and without students.

When the institution opened, in 1866, its course of study was remodeled. In this reorganization the plan of the University of Virginia was followed. In the prospectus we read that "the university consists of eight schools;" that students are allowed to choose the departments which they wish to pursue, provided they enter at least three schools. In certain cases, however, students will be allowed to enter less than three schools."

The prospectus continues, as follows: "During the present year there will be no examinations or other requirements for admission, except that the applicant must be at least fifteen years of age; but in order to ensure uniformity of preparation in certain departments, a preparatory course has been prescribed, and after *this year* applicants (under eighteen years of age) will be required to bring a satisfactory certificate of proficiency, or to stand an examination. For applicants over eighteen years of age, no examination or certificate will be required during the next year."



"In all the different schools the method of instruction is by means of lectures and the study of text-books, accompanied in either case by rigid daily examinations."

In the "school of mathematics, and civil and military engineering and construction," the requirements for admission were: "Arithmetic in all its branches, including the extraction of square and cube roots;" "algebra, through equations of the second degree."

From 1867 to 1872 the terms were as above, together with "a knowledge of the first four books of geometry," which, "though not indispensable, is very desirable."

In 1872 the management of the university fell under the Reconstruction administration; negroes were admitted, and a four years' preparatory course was given. The catalogue of 1872-73 says:

"In arithmetic, attention should be paid to all the rules and calculations usually given in written arithmetic, and too much importance can not be paid to a thorough preliminary drill in mental arithmetic."

In the "college of literature, science, and the arts," the requirements are, in addition, for the *classical course*, "algebra, as far as equations of the second degree," and it is "recommended that they also master the first four books in Davies' Legendre, or the equivalent;" for the scientific course, "algebra, up to radical quantities."

In the catalogue for 1876, the requirements were "the whole of arithmetic," and "algebra as far as equations of the second degree."

The course of study in mathematics was, in 1866, algebra from equations of the second degree to general theory of equations and logarithms, geometry, plane and spherical trigonometry, surveying and the use of instruments, in the first year; in the second year, descriptive geometry, analytical geometry, calculus, mathematical drawing. Text-books: Loomis's books on algebra and geometry, Davies' Shades, Shadows, and Perspective, Church's Analytical Geometry and Calculus. In the "department of mechanical philosophy and astronomy," Prof. John Le Conte's *Mechanics* was taught, also Olmsted's *Astronomy*, with Herschel's *Outlines* and Norton's *Astronomy* for reference. In 1867 Loomis's *Astronomy* was used, as well as his series of mathematical text-books from his *Algebra* to his *Calculus*. In 1870 everything is the same as given above, except that mechanical philosophy and astronomy were temporarily taught by the professor of mathematics.

In 1872 Robinson's University Algebra and Loomis's Geometry were studied in the first year; Robinson's Trigonometry, Mensuration, Surveying, and Spherical Trigonometry in the second year; Robinson's Analytical Geometry and Conic Sections the third year. Later on Peacock's Algebra was introduced.

"In 1879 the trustees of the university were empowered by act of the General Assembly to establish a College of Agriculture and Mechanics at Columbia, and to use the property and grounds of the college for this purpose. This was accordingly done in 1880."

"In 1881 the Legislature granted an annual appropriation for the support of the schools of the university, and in 1882 the South Carolina College was reorganized by the appointment of a full faculty. It went into active operation the fall of the same year."

From 1882 to 1888 Benjamin Sloan was the professor of mathematics. At present he is professor of physics and civil engineering. He is a South Carolinian, graduated at West Point in 1860, served in New Mexico before the War, and then entered into the Confederate service. The story goes that when he entered upon the duties of his chair at the college, he ordered a bookseller to get Courtenay's Calculus. "Calculus!" replied the bookseller, "what are you going to do with it?" "Teach it," was the reply. "You can't do that, no South Carolina boy ever studies calculus." Though this be merely the opinion of a jovial bookseller, it is, we fear, not without some truth when applied to the ten years preceding the reorganization and re-opening of the college in 1882. For four years it was under Reconstruction rule, and for six years its doors were closed to students.

Professor Sloan is a first-class teacher. He requires a great deal of original work of students, and inspires considerable enthusiasm. In his manner he is very quiet and easy. Among the students he is liked and popular.

In 1888 Dr. E. W. Davis was elected to the mathematical chair. He graduated at the University of Wisconsin in 1879, and after spending some time at the Washington Astronomical Observatory, went to the Johns Hopkins University, where for four years he studied mathematics under Professor Sylvester and his associates. As a subsidiary study Davis pursued physics under Professor Hastings. At this great university he soon caught the spirit and enthusiasm which is so contagious there. His mind was chiefly bent toward geometrical studies, and the papers from his pen, which are published in the Johns Hopkins University Circulars and the American Journal of Mathematics are evidences of his power as an original investigator. Before his appointment to his present position he was professor of mathematics for four years at the Florida Agricultural College in Lake City. In his teaching Professor Davis possesses great power in causing students to think. He is a bold advocate of greater freedom from formalism in mathematical instruction.

The terms for admission on the re-opening of the institution were, in mathematics, arithmetic, and algebra through equations of the first degree. Radicals were added in 1883. In 1884 the terms were, arithmetic, and algebra to equations of the second degree. No additions have been made since.

The mathematical course in 1882 consisted, in the first year, in the study of Newcomb's Algebra, Chauvenet's Geometry (six books); in the second year, in the study of Newcomb's Plane and Spherical Trigonometry, Puckle's Conic Sections; in the third year, in the further study

of conic sections (Puckle, Olney), and calculus (Olney, Todhunter). In applied mathematics courses were given in the second year on surveying (Gillespie) and drawing, Peck's *Mechanics*, Wood's *Strength and Resistance of Materials*, and Walton's *Problems in Elementary Mechanics*, astronomy (Loomis, Newcomb, and Holden), and Mahan's *Civil Engineering*. In 1884 Warren became the text-book in descriptive geometry. In 1885 Taylor's *Calculus* was introduced; in 1886 Watson's *Descriptive Geometry* and Merriam's *Least Squares*; in 1887 Newcomb's *Analytic Geometry*.

The mathematical text-books for 1888 are, in the first year, Todhunter's *Algebra for Beginners*, Byerly's *Chauvenet's Geometry*; in the second year, Blakie's *Plane and Spherical Trigonometry*, Peirce's *Tables*; in the third year, Taylor's *Calculus*, Church's *Descriptive Geometry*; in the fourth year, Newcomb and Holden's *Shorter Course in Astronomy*.

This year (1888-89) a graduate department has been added. In mathematics it offers the following branches: Algebra (theory of equations, theory of determinants, etc.), geometry (projective geometry, higher plane curves, etc.), calculus (differential equations and finite differences), elliptic functions, astronomy, and quaternions.

#### UNIVERSITY OF ALABAMA.\*

The University of Alabama was opened in 1831, with Gordon Saltonstall in charge of the mathematical teaching. Two years later William W. Hudson became professor of mathematics, and held the position until 1837, when Frederick Augustus Porter Barnard became connected with the institution, and had charge of the mathematical department till 1849. The wonderful activity of this powerful man in the various departments of science gave a great stimulus to higher education in the State. He had previously been tutor at his *alma mater*, Yale. In 1849 he assumed the duties of the chair of chemistry at the University of Alabama. While connected with the institution as professor of mathematics and natural philosophy he wrote and published an arithmetic, which came for a time into pretty general use in Alabama. In 1846 he was appointed astronomer by the State, to settle a boundary dispute between Alabama and Florida. He was appointed astronomer for the State of Florida also, so that he represented both States in the settlement of the dispute. Professor Barnard was always fond of mathematics. He has written a number of valuable articles on mathematical subjects for Johnson's *New Universal Cyclopaedia*.

By old students Professor Barnard is always spoken of in most laudable terms. Says Dr. B. Manly: "To me the study of physics, astronomy, etc., under Prof. F. A. P. Barnard, • • • and of chemistry and kindred sciences under Prof. R. H. Bramby, long deceased, were the

\* Nearly all the material for this article was sent us by Prof. T. W. Palmer, professor of mathematics at the university.

most attractive parts of my college course." Mr. John A. Foster, now chancellor of the south-eastern chancery division of Alabama, was a student and then a tutor of mathematics at the university in the time that Barnard taught there. He says:

"I entered the Sophomore class of the University of Alabama at Tuscaloosa in the autumn of 1844, and received my diploma in August, 1847, in a class of eighteen. During my college course Prof. F. A. P. Barnard was the professor of mathematics and John G. Barr was the assistant professor of mathematics. Dr. Barnard afterward became the president of the University of Mississippi, and in 1861, being a Union man, resigned and went North, where he was for some time engaged in the scientific department of the Government, and afterward was president of Columbia College in the city of New York. A very short time ago I observed that he has retired from this work.

"Professor Barnard was not less distinguished as a scientist than as a mathematician. His reputation is world wide. I was a great friend of his, and up to 1858 I was a constant correspondent with him. I need hardly say that his instruction was thorough and far in advance of the methods which prevailed at that time. There has never been a better teacher of mathematics, and those now living still claim that the country is but now getting to the methods of teaching practiced by him more than forty years ago. Withal, he was a warm and generous friend, and was very popular with those who were his pupils. During the summer of 1844 or 1845 he went to Europe and spent some time in France, and on his return to the university he brought with him the newly discovered Daguerrean process, and took pictures experimentally before his class. He was hard of hearing and had a deep guttural voice, but no one had a happier faculty of making himself clearly understood. He married an English lady while I was his pupil.

"Capt. John G. Barr, the assistant professor, was worthy to occupy the position as second to this distinguished man. In 1847 he raised a company and went to the Mexican War, where he served with distinction until its close. Soon after he was appointed to a diplomatic position by the United States Government, and died at sea when on his way out to assume the duties of his official station. He was an able and successful teacher of mathematics."

Mr. Foster engaged in educational work till 1859 (being for some years president of a college in La Grange, Ga.), when he went to the practice of law.

The mathematical teaching at the university for the three years succeeding 1849 was in the hands of Prof. Laudon Cabell Garland, now the honored chancellor and professor of natural philosophy and astronomy of Vanderbilt University. His successors as instructors of mathematics at the University of Alabama, before the War, were Profs. George Benagh (1852-60), Robert Kennon Hargrove (1855-57), James T. Murfee (1860-61), and William Jones Vaughn (1863-65).

Prof. B. K. Hargrove, after teaching mathematics for two years, joined the ministry of the M. E. Church South, and, a few years ago, was elected bishop by the general conference which met at Nashville, Tenn.

The terms for admission to the university were, 1833-56, arithmetic; 1857-59, arithmetic, and algebra through equations of the second degree; 1860-62, arithmetic, and algebra to equations of the first degree; the records for the next three years are lost.

Down to 1852 the professor of mathematics was at the same time professor of physics, according to the usual custom in American colleges at that day. In 1833 the Freshman class completed algebra (Colburn, Lacroix) and commenced geometry (Farrar's Legendre); the Sophomore class studied geometry, trigonometry, and conic sections. The Junior and Senior classes were taught mechanics, statics, heat, light, electricity, etc. The books used were the Cambridge Mathematics of Professor Farrar. This course continued without change until 1842, when surveying, mensuration, etc., were made an important part of the Sophomore work. In 1843 Davies' text-books were adopted. In 1845 Peirce's Algebra was introduced, but after two years it was displaced by Davies'. In 1849 the calculus was added to the Junior course. The text used was Church's until 1855, when Loomis's was adopted. From 1860 to 1865 the records are so incomplete that it is impossible to state whether or not any changes were made during that time.

Before the War, the university was prospering. "In the Junior and Senior classes," says Mr. Foster (class of 1847), "much attention was given to applied mathematics. Physics, astronomy, surveying, and navigation were taught. The university was but a college with a fine corps of professors, and presented advantages offered by very few other institutions of learning at that time."

The War naturally interfered with the successful working of the university. In 1865 the university buildings were destroyed by fire, and the institution was not opened again until 1869. The condition of the country at that time was not favorable for the advancement of education. In recent years, however, decided and encouraging progress has been made. A thrill of aspiration and enthusiasm has been running through Southern colleges.

The first year after the re-opening Prof. N. R. Chambliss taught the mathematics; the next year, Prof. J. D. F. Richards; and the year following, Prof. Hampton S. Whitfield, and the fourth year Prof. David L. Peck. In 1872-73 Prof. W. J. Vaughn held the mathematical chair; and from 1873 to 1878 Prof. H. S. Whitfield again. In 1878 Professor Vaughn assumed the duties of this chair for the third time, and discharged them for four years. Since 1882 Prof. Thomas Waverly Palmer has filled the chair and taught with marked success.

Vaughn is now professor of mathematics at Vanderbilt University. "Though he has never written text-books," says Professor Palmer, "still

he is justly regarded as one of the ablest mathematicians in our American colleges." Prof. J. K. Powers, president of the Alabama State Normal School, who studied at the university from 1871 to 1873, says that he had completed the course in pure mathematics before going there, and that he took applied mathematics there. "Prof. Wm. J. Vaughn at that time filled the chair of applied mathematics. He was (and is) an accomplished mathematician, an attractive instructor, a fine general scholar, and a charming gentleman. At that time the chair of pure mathematics was filled by Prof. D. L. Peck and Prof. H. S. Whitfield. I *knew* nothing of their methods, but *pure mathematics* was not popular in those days. In after years, when Prof. Vaughn assumed control of that work, no department of the university was more popular."

Of Professor Palmer, Chester Harding (class of '84, now a cadet at the U. S. Military Academy at West Point) says: "This gentleman, a graduate of the class of '81 of the university, had so satisfactorily filled the position of assistant professor during the preceding term, that his election was secured, as young as he was, against the claims of other applicants of extensive experience, reputation, and influence."

From 1869 to 1871 only the elements of arithmetic were required for admission. During the next two years, algebra to equations of the second degree was added. In 1873 the requirements were reduced to arithmetical alone. No change was made until 1878, when algebra through equations of the second degree was required. Gradual changes have been made every year since, and now the whole of algebra and three books of geometry are required.

The catalogue for 1887-88 states that the candidate for admission "must pass a satisfactory examination in arithmetic, in algebra through arithmetical and geometrical progression, and in the first two books of geometry. The examination in arithmetic will include the whole subject as embraced in such works as White's, Robinson's, Goff's, Greenleaf's, or Sandford's higher arithmetic. In algebra, particular stress will be placed upon the use of parentheses, factoring, highest common factor, lowest common multiple, simple and complex fractions, simple equations with one or more unknown quantities, involution, evolution, theory of exponents, radicals (including rationalization, imaginary quantities, properties of quadratic surds, square root of a binomial surd, and solution of equations containing radicals), quadratic equations, equations of the quadratic form, simultaneous quadratic equations, ratio and proportion, arithmetical and geometrical progression."

In 1874 the calculus was dropped from the university course, but was introduced again in 1878.

In 1881 there was a reorganization of the courses of study. Two courses of mathematics were arranged, one for classical and scientific students, and one for engineering students. The course for classical or scientific students embraced algebra, geometry, plane and spherical trigonometry, and analytic geometry. These subjects were completed

in the Sophomore class. Since 1881 no changes have been made in the classical and scientific courses.

The engineering course embraced all subjects that were taught in the classical and scientific, but to the Sophomore work was added descriptive geometry, and to the Junior class calculus. This course has been modified since. At present it consists of higher algebra and geometry for the Freshmen; plane and spherical trigonometry, analytical geometry, descriptive geometry, theory of equations, for the Sophomores; calculus, determinants, and quaternions for the Juniors.

Determinants and quaternions, which are regularly in the course since 1887, have been taught irregularly for several years. Quaternions are, according to catalogue, now taught in the third term of the Sophomore year, before the completion of analytic geometry. This is a somewhat new departure in the arrangement of mathematical studies, and one which is worthy of respectable and thoughtful consideration.

As to text-books, in 1871 Davies' Algebra and Geometry were used; also Church's Analytic Geometry and Calculus. In 1872 and 1873 the books were Robinson's Algebra and Geometry, and Loomis's Trigonometry and Analytic Geometry. In 1878 Peck's Analytic Geometry and Calculus were introduced. The books used at present are Wall's Algebra, Wentworth's Geometry, Trigonometry, and Analytic Geometry, Bowser's Analytic Geometry, Taylor's Calculus, Church's Descriptive Geometry, Peck's Determinants, and Todhunter's Theory of Equations.

Cadet Chester Harding, who was a student at the University of Alabama from 1881 to 1884, gives the following reminiscences of the mathematical teaching there: "The training in mathematics was more extensive in scope and thoroughness in the engineering course than in the others, including in that course the elementary principles of descriptive geometry and calculus, while in the others the instruction ceased with the study of the conic sections and surfaces of the second order in analytical geometry.

"I chose the engineering course and began my instructions in the department of mathematics with trigonometry under Prof. W. J. Vaughn, who now fills the chair of mathematics at Vanderbilt University. Our text book was Wheeler's Trigonometry. The trigonometric functions were taught as ratios, and stress was laid upon the circular system of measuring angles. • • •

"Analytical geometry came next, and our text book was Professor Wood's Elements of Co-ordinate Geometry. Of the class of thirty in this branch, all were beginners but two or three who had been required to repeat the course because of their deficiency in the preceding year. Our progress was therefore slow at first, and much time was spent by the professor in explanations and illustrations. I see the first lessons still marked in the text book I have before me now, and some were but two and a half of the quarto pages. These, however, were expected to

be thoroughly mastered, and many pains were taken to have the principles well absorbed by the students. Mere exercise of memory was little sought after in the mathematical department, and any originality on the part of a student in the deduction or application of a principle was highly commended.

"The course in analytical geometry closed with the end of the session, at which time a satisfactory written examination in the study was required of every member of the class. In the scientific and classical courses, mathematics terminated with the Sophomore year. In the Junior year the students of the engineering course, however, took up the study of calculus.

"At the end of my Sophomore year Professor Vaughn resigned his chair at the University of Alabama to accept a similar position at Vanderbilt. • • •

"In my Junior year the schedule of studies was so arranged that but three hours a week were devoted by my class to mathematics. This limited time permitted us to complete but one text-book, Prof. W. G. Peck's Elements of the Differential and Integral Calculus. From this text, however, we derived a knowledge of the practical utility of calculus, and became familiarized with the rules of differentiation and integration. I can hardly say that we acquired a more thorough knowledge than this; and indeed it seemed, from the time assigned to the study, to be without the purpose of the faculty that more than a groundwork should be acquired, for practical good in the understanding of the applications of calculus to mechanics and engineering. During my Junior year we also studied under Prof. R. A. Hardaway, in the department of engineering, the elements of descriptive geometry, using as a text-book Biun's Elements of Orthographic Projection.

"With the close of the Junior year the regular course in pure mathematics was ended."

As regards the conditions for graduation which have existed at various times, Professor Palmer says: "As a rule mathematics was required of every student for graduation, from 1831 to 1865. After the reorganization in 1869, mathematics was also required until 1875, when the elective system was adopted; it was entirely optional with the student then until 1880, when every student was required to take this subject through analytic geometry."

At present there are no electives, and all the mathematics in each course is required for a degree in that course.

#### UNIVERSITY OF MISSISSIPPI.

The educational record of Mississippi in the early period of her organized existence is quite honorable. Between 1798 and 1848 there had been established one hundred and ten institutions, under the various names of universities, colleges, academies, and schools. This proves that an entire obliviousness to the educational wants of the people did



not prevail. Our gratification is abated, however, by the consideration that these organizations proved inefficient, and that there was really but very little beneficial progress.

In 1848 was organized upon a firmer foundation the University of Mississippi. Considering the many difficulties that were encountered, the record of the university during its infant years before the War was honorable. Two names, both well known to the educational public, devoted their energies to promote its early growth—F. A. P. Barnard, now president of Columbia College, and A. T. Bledsoe, afterward professor at the University of Virginia and, still later, editor of the *Southern Methodist Review*.

From the beginning until 1854, Albert Taylor Bledsoe was professor of pure and applied mathematics, and astronomy. The mathematical requirements for admission were, at first, a knowledge of arithmetic. The catalogue of 1857-58 says: "Arithmetic—especially the subject of fractions, vulgar and decimal, proportion, and the extraction of roots;" the catalogue for 1859-60 adds to this, "algebra as far as simple equations." In the former catalogue we read also, "that, hereafter, no student will be admitted to any class in the university who shall fail to pass an entirely satisfactory examination on the subjects or authors required for admission to the class."

According to the catalogue of 1854, the *Freshmen* studied Davies' University Arithmetic, Davies' Bourdon, and Davies' Legendre; the *Sophomores* continued Davies' Bourdon and Legendre, and then took up Plane and Spherical Trigonometry and Surveying; the *Juniors* studied Descriptive Geometry, Shades and Shadows and Perspective, Davies' Analytical Geometry, and Descriptive Astronomy; the *Seniors*, Davies' Differential and Integral Calculus, and physical astronomy. In the introduction into the course of descriptive geometry, in the use throughout of Davies' text-books, and in the apparent thoroughness (for that time) of the mathematical course, we observe the influence of the U. S. Military Academy, through Professor Bledsoe, a West Point graduate.

When Bledsoe resigned to accept a professorship at the University of Virginia, Frederick Augustus Porter Barnard, a young man of remarkable mathematical talents, took his place. Barnard was a native of Massachusetts and entered Yale college in 1824. Before admittance to college he had given no time to mathematical study beyond the elements of arithmetic, but in college he began to exhibit decided mathematical talent and taste. His tutor, W. H. Holland, later professor of mathematics in Trinity College, Hartford, said of him: "I have never known any person except the late lamented Professor Fisher, who possessed so extraordinary natural aptitude." After graduation he was, for a time, tutor at Yale, then professor at the University of Alabama, and, in 1854, became Bledsoe's successor at the University of Mississippi. At the meeting of the board of trustees, in July, 1856, the chair of pure and applied mathematics and astronomy was divided into two,

the chair of pure mathematics, and the chair of natural science, civil engineering, and astronomy. Professor Barnard held the latter, though he continued to exercise supervision over the former, and was also elected president of the university. He filled these offices until the suspension of the exercises of the university, in 1861.

From 1856 to 1861 Jordan McCulloch Phipps was teacher of mathematics—at first adjunct professor, afterward full professor. Daniel B. Carr was tutor. The department of mathematics, physics, and engineering seems to have been the strongest at the institution. In consequence of frequent complaint that the general statement previously presented in the annual catalogues of the university had been unsatisfactory, a complete account of expenses and of the courses of instruction was given in the catalogues issued at this time. From the one of 1857-58 we quote the following:

“Instruction in pure mathematics commences with the beginning of the Freshman year, and is continued till the close of the Sophomore. In order to secure greater efficiency of instruction, the class will be divided into sections, which will be met by the instructor separately; and all operations in this and every other branch of mathematical science will be actually performed by the student in his presence, upon large wall-slates or blackboards. The instructor will also avail himself of the same means of illustrating processes, or principles, and explaining difficulties.

“The first subject attended to is algebra. It will be the instructor's endeavor to secure a thorough acquaintance with the elementary principles of the science, and a perfect familiarity with its practical operations. The subject of fractions will be especially dwelt on, after which will follow the resolution of simple equations, numerical and literal, involving one or more unknown quantities. In taking up, next in order, quadratic equations, the first object will be to secure on the part of the student a perfect understanding of the form of the binomial square; and this will be afterward applied to the completion of imperfect squares, in the several cases in which one of the terms of the root is a number, or a letter, or a numerical or literal fraction. The method being generalized, will then be applied to the reduction of abstract equations, and the statement and resolution of problems involving quadratics. Where the equation is denominate, the student will be required to interpret the result, to explain the ambiguous sign, and to distinguish cases in which the conditions of the problem involve an impossibility. • • •

“The subject of algebra will be completed by the discussion of the general theory of equations, their formation, their solution, and their properties, including in the course the ingenious theorem of Sturm.

“In all parts of this subject, encouragement will be held out to students to exercise their ingenuity in devising various modes of arriving at the same results; and special merit will be attached to the processes

which are the most succinct or elegant. As a stimulus to this species of ingenuity, problems not embraced in the text-book may from time to time be proposed by the instructor; and varieties in the mode of statement both of these and of those which occur in the regular course, will be called for from any who may choose to present them.

"Geometry, plane, solid, and spherical, will occupy the latter portion of the Freshman year. In this branch of science all demonstrations will be made from figures drawn upon the blackboards, or wall-slates, by the student reciting, and promptness and accuracy in this part of the business will be urgently inculcated and regarded as a merit. The student will, moreover, be advised to avoid a servile imitation of the exact forms of the diagrams given in the text-book, and will have his ingenuity exercised either in forming other figures to illustrate the same propositions, or in demonstrating the propositions from figures constructed for him. He will also be required to adopt a mode of lettering his figures different from that of the book; or to give the demonstrations without the use of letters at all, by pointing to the parts of the figure successively referred to in the demonstration.

"It will always be regarded as specially meritorious in a student to present a demonstration of any proposition founded on any legitimate method differing from that of the author; and the instructor will, himself, from time to time, illustrate this practice, by way of awakening the ingenuity of the student. For the purpose of still further encouraging originality of investigation, and exciting honorable emulation, the plan already described as to be pursued in algebra, will be continued here, of propounding propositions not contained in the text-book, of which demonstrations will be subsequently called for, and which will secure special distinction to such as satisfactorily solve them."

Equally full is the account of the mathematical work in the Sophomore year. The studies for that year were plane and spherical trigonometry, mensuration, surveying, leveling, navigation, and analytical geometry. Considerable field-work was done in surveying. The leveling was employed both the common division to feet and fractions, and also the French metrical division.

The catalogue then proceeds as follows:

"The course of pure mathematics will conclude with the subject of the differential and integral calculus, which will be taught at the end of the Sophomore or the beginning of the Junior year. This will embrace the doctrine of functions, algebraic and transcendental, the differential of such functions, successive differentials, theorems of Taylor and Maclaurin, logarithmic series, the development of a circular arc in terms of its functions, or of the functions in terms of the arc, partial differentials, differential equations of curves, principles of maxima and minima, expressions for tangents and normals, singular and multiple points, osculating circles, involutes and evolutes, transcendental curves, and spirals; the integration of regularly formed differentials, integra-

tion by series, integration of rational and irrational fractions, special methods of integration, the rectification of curves, the quadrature of curves and curved surfaces, the cubature of solids, and the integration of differentials of two or more variables."

In natural philosophy great efforts were made to secure a complete set of apparatus. In the catalogue for 1857-58 we read as follows: "It is probable that, with the opening of the ensuing session, the electrical apparatus of the University of Mississippi will be superior to any similar collection in the United States."

In astronomy the celestial motions were beautifully represented by Barlow's magnificent planetarium, eleven feet in diameter—"a piece of mechanism unrivaled in ingenuity, accuracy, and elegance." A portable transit instrument was also available for observations of meridian passages, and a sextant and a prismatic reflecting circle furnished means of making direct measurements of altitudes and arcs. The catalogue then says:

"The course of civil engineering, distinctly so called, falls entirely within the Senior year; but it is in considerable part only a further development and application of principles embraced in the sciences of pure mathematics and physics previously taught. The course will embrace geometrical and topographical drawing, the use of field instruments, such as the engineer's transit, the goniasometer or pantometer, the leveling instrument, the theodolite, the sextant, the reflecting circle, and the plane table, descriptive geometry, trigonometrical surveying and geodesy, marine surveys, materials of structures, engineering statics, carpentry, masonry, bridge construction, surveys for location and construction of roads and railroads, laying out curves, staking out cuts and fills, hydraulic engineering, drainage, canals, locks, aqueducts, dams, sea walls, river improvements, and the dynamics and economy of transportation. • • •

"Throughout every part of the course, the student will be constantly encouraged and stimulated to consult other authorities on the subjects taught, besides the text-books: and the instructors will often refer them on special subjects, to such authorities. The following list embraces the text-books (first in order), and the authors to whom reference will most frequently be made:

- "ALGEBRA: Perkins, Hackley, Peirce.
- GEOMETRY: Perkins, Playfair (Euclid), Peirce.
- TRIGONOMETRY: Perkins, Hackley, Peirce.
- SURVEYING: Gillespie, Davies, Gummere.
- ANALYTICAL GEOMETRY: Davies, Peirce.
- CALCULUS: Davies, Peirce, Church, Jephson.
- NATURAL PHILOSOPHY: Olmsted, Bartlett, Whewell, Brewster (Optics), Herschel (Light and Sound), Peirce.
- ASTRONOMY: Olmsted, Gummere, Bartlett, Loomis.
- CIVIL ENGINEERING: Mahan, Moseley, Wiesbach, Gillespie, Haupt, Bourne, Pambour."

The courses for the remaining years before the War were essentially the same as the one we have described. The constant use of the blackboard is emphasized throughout. The fact that pains are taken to explain the term as meaning "large wall-slates" rather tends to show that blackboards were then a novelty in Mississippi. As far as we can judge from the catalogues, the instruction was methodical and of high efficiency. A serious drawback to high scholarship was found, no doubt, in the lack of preliminary culture and training in students entering the university.

The attendance of students was good. The number of graduates from the department of arts from 1851 to 1859, inclusive, was 268. During the last year before the War the number of students in the college was 191, of whom 16 were "irregular" in grade.

Owing to the universal enlistment of males, even youths, in the Confederate States army, the university exercises were suspended in 1861, until October 1865. In 1865 General Claudius W. Sears, ex-brigadier-general of the Confederate States army, and a graduate of West Point, was elected professor of mathematics. This position he still holds.

The mathematical requirements for entering were, in 1866, "arithmetic and algebra, including equations of the first degree." The course of pure mathematics for the regular under graduate curriculum was completed at the end of the Sophomore year, and consisted of Bourdon's Algebra, Legendre's Geometry, Trigonometry, Mensuration, Surveying, and Analytical Geometry.

A more extended course than was required for the degree of bachelor of arts could be obtained in the department of applied mathematics and civil engineering, which was in charge of General F. A. Shoup, a graduate of West Point, and now of the University of the South. The course of instruction in his department formed no necessary part of the under graduate course. It was designed to meet the wants of such students as intended to make civil engineering or some other of the mechanic arts a profession. In this course analytical geometry and calculus were, of course, indispensable, and they could be studied while students were pursuing their branches in the department proper. The course could be completed by an ordinary student who came fairly well prepared in preliminary branches in about two years.

In 1870 the plan of instruction in the university was altered so as to include (1) a department of preparatory education, (2) a department of science, literature, and arts leading, respectively, to the degrees of B. A., B. S., B. Phil., C. E., and (3) a department of professional education (law).

The terms for admission into the bachelor of arts and bachelor of science courses were, in mathematics, arithmetic, and Davies' Elementary Algebra through equations of the second degree. Candidates for the bachelor of philosophy course and civil engineering were examined on the whole of Davies' Elementary Algebra. These requirements

have remained unchanged till the present time. The department of civil engineering was discontinued in 1876. In 1872 the first year's mathematical work in the course leading to the B. A., B. S., and B. Ph. degrees consisted in the study of Davies' Bourdon's Algebra, and Legendre's Geometry and Plane Trigonometry. During the first half of the Sophomore year Church's Analytical Geometry and Davies' Land Surveying (with use of instruments in the field) were studied. This completed the course in pure mathematics. A. B. students were taught Smith's Mechanics and Hydrostatics, Hydraulics, and Sound (Bartlett) in the Junior year, and Bartlett's Optics and Astronomy in the Senior year. B. S. students had Gummere's Astronomy in the second half of the third year. (The B. S. and B. Ph. were the only three years' courses.)

At the present time (1888) the mathematical course is decidedly stronger. Van Amringe's edition of Davies' text-books are used, except in analytical geometry and calculus, which are studied from the works of Church. The calculus is now studied during the latter part of the Sophomore year.

Prof. C. W. Sears has now occupied the mathematical chair for twenty-three years. One of his old pupils, Prof. Edward Mayes, says of him, "that he 'quizzes' 'like all possessed,' pretends that he does not know anything about it, and asks 'all sorts of impertinent questions.'" As Sydney Smith said of Alexander Pope, "I studied under him, and have lively recollections."

#### KENTUCKY UNIVERSITY.

The records of the Transylvania University for several years following 1817 appear to have been lost. In 1825 Thomas J. Matthews, the father of the late Justice Stanley Matthews, of the Supreme Court of the United States, is mentioned as being "professor of mathematics and natural philosophy." The subjects taught by him were "arithmetic, geometry, surveying, leveling, natural philosophy, and book-keeping." The entry for 1829 shows that Pestalozzian ideas had gained a foothold at the university, inasmuch as Colburn's Algebra is mentioned as the mathematical text-book for the *Freshmen*. The *Sophomores* studied Playfair's Geometry and Trigonometry; the *Juniors*, Day's Navigation, Surveying, Heights and Distances, Leveling; the *Seniors*, Bezout's Fluxions. Bezout's text-book had been translated from the French by Professor Farrar, of Harvard. It employed the notation of Leibnitz, and did not therefore teach "fluxions." The use of this term as a synonym for "differential and integral calculus" was, we believe, peculiarly American.

In 1832 John Lutz was elected "professor of mathematics and natural philosophy," and in 1837 Benjamin Moore. The latter resigned after one year's service.

The records from 1839 to 1865 can not be found. From old catalogues we glean the following: In 1844 R. T. P. Allen was professor, and the subjects taught were, in the *Freshman* year, Davies' Bourdon and Legendre; in the *Sophomore* year, plane and spherical trigonometry, heights and distances, mensuration of superficies and solids (Davies'), navigation (Day's), conic sections (Davies' Analytical Geometry), Surveying (Davies'), descriptive geometry (Davies'); in the *Junior* year, differential and integral calculus (Davies'); in the *Senior* year, Olmsted's Astronomy.

In 1848 James B. Dodd held the chair of mathematics and natural philosophy. At this time the course was as follows: *Freshmen* year, arithmetic reviewed, Loomis's Algebra, five books of Legendre; *Sophomore* year, geometry completed, plane and spherical trigonometry and their applications, analytical geometry (Davies', 6 books); *Junior* year, Church's Calculus.

In 1850 the mathematics for the Junior and Senior classes consisted of descriptive geometry, analytical geometry, calculus, and analytical mechanics; but they were optional with the student.

Prof. James B. Dodd was the most prominent mathematical teacher that was connected with Transylvania University. He was a native of Virginia, and a self-made mathematician. In 1841 he became professor of mathematics at the Centenary College in Mississippi, and in 1846 was elected professor at the Transylvania University. He published several books, viz., an Elementary and Practical Arithmetic, High School Arithmetic, Elementary and Practical Algebra, Algebra for High Schools and Colleges, and Elements of Geometry and Mensuration. Some of these reached several editions. Professor Dodd contributed also to the Quarterly Review of the M. E. Church South. In 1849 he was appointed president *pro tempore* of the university.

In 1865 Transylvania University was merged into Kentucky University. The chair of mathematics in Kentucky University has been filled from 1859 to the present time by Henry H. White. From 1870 to 1876 James G. White acted as adjunct professor. From 1876 to 1878 he was professor. In mathematics the requirement for admission has been algebra through equations of the first degree. When Prof. Henry H. White first became connected with the university as professor, the course was as follows: Algebra completed, plane and solid geometry, application of algebra to geometry, plane and spherical trigonometry, surveying and navigation, analytical geometry, differential and integral calculus, mechanics, and astronomy, with original problems and exercises throughout the course when practicable. In 1864 the course was modified by dropping applications of algebra to geometry; in 1879, by the addition of conic sections (treated geometrically); and in 1884, by dropping conic sections and navigation.

The text-books used by Prof. Henry H. White at different times are as follows: In *Algebra*, Davies' Bourdon, Towne, Peck; in *Geometry*,

Davies' Legendre, Peck; in *Trigonometry*, Davies, Peck; in *Surveying and Navigation*, Davies, Loomis; in *Analytical Geometry*, Loomis, Peck; in *Calculus*, Loomis, Peck; in *Mechanics*, Olmsted, Snell's Olmsted, Peck; in *Astronomy*, Olmsted, Snell's Olmsted, Peck.

There have been no electives in mathematics up to this time, except that the student now has the choice between languages and calculus.

#### UNIVERSITY OF TENNESSEE.\*

"The foundation of this university is connected with the earliest history of Tennessee.

"In 1794, by the first General Assembly of the 'Territory south of the Ohio,' was chartered Blount College, named in honor of William Blount, Governor of the Territory, and afterward one of the two United States Senators first chosen from the State of Tennessee.

"In 1807, under an act of Congress providing for the establishment of two colleges in Tennessee, East Tennessee College was chartered, and soon after the franchise and property of Blount College were transferred to the new institution. • • •

"In 1810 the name of East Tennessee College was changed, by act of Legislature, to East Tennessee University.

"In 1869 the Legislature gave in trust to the university the proceeds of the sale of public lands, donated by act of Congress of July 2, 1862, 'to the several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts.'

"In 1879 the name of East Tennessee University was changed, by an act of the Legislature, to the University of Tennessee."†

It is a source of regret to us that we have not been able to obtain any information whatever on the mathematical instruction at this institution during the first eighty years of its existence. Ever since it took the name of a university, it has been in an almost continual state of reorganization. These constant upheavals have resulted in the loss of almost all its records. "The requirements for admission and graduation," says Professor Carson, "have probably been changed, on an average, every two years." The terms for admission were not rigidly adhered to, and the standard for graduation has not always been high.

The catalogue of 1874-75, the earliest one that we have, gives John Kerr Payne as professor of mathematics and mechanical philosophy. The collegiate department comprised at this time three distinct courses viz., the agricultural course, the mechanical course, and the classical course. The standard for admission to the first two courses was, until 1874, lower than to the last course. In 1874-75 the mathematical studies in the agricultural course were according to catalogue, as fol-

\* The writer is indebted to Prof. Wm. W. Carson, professor of mathematics and civil engineering at the University of Tennessee, for all the information herein contained.

† Catalogue of the University of Tennessee, 1895-96.



lows: *Freshmen*, Robinson's University Algebra, beginning with quadratic equations, Chauvenet's Geometry, beginning at the third book, Loomis's Conic Sections; *Sophomores*, Church's Descriptive Geometry, Loomis's Trigonometry and Surveying; *Juniors*, Olmsted's Natural Philosophy and Astronomy. In the mechanical and classical courses, the schedule was the same in mathematics, except that spherical trigonometry, Loomis's Analytical Geometry and Calculus, and civil engineering, were added.

The biennial report of the trustees for 1881 gives James Dinwiddie as professor of pure mathematics, and Samuel H. Lockett as professor of applied mathematics and mechanical philosophy. The report shows that the university was then organized into distinct schools, like the University of Virginia. These schools have existed, probably, since 1872. Of the school of pure mathematics, the report says:

"The subjects taught in the subcollegiate year of this school are elementary algebra, and four books of geometry. In the first collegiate year algebra and geometry are finished, and plane trigonometry is studied. In the second collegiate year are studied spherical trigonometry and analytical geometry of two dimensions, and in the third year differential and integral calculus."

The work in the school of applied mathematics is described as follows:

"Elementary experimental physics is taught in the first college year. The various subjects of statics and dynamics of solids, liquids, and gases; of acoustics, heat, light, electricity, and magnetism, are treated without the aid of the mathematics, and are illustrated by numerous experiments. The apparatus has been specially selected for that purpose.

"In the analytical mechanics, the power of the whole range of the mathematics is brought to bear upon the investigation of the laws of forces of nature, and the student is made familiar with the power and utility of mathematics by the solution of a large number of practical problems. Astronomy has thus far been taught without instruments, but the board of trustees has appropriated five hundred dollars for the purchase of a telescope. Surveying comprehends plane surveying, leveling, topographical surveying, and mining surveying; the use of the compass, transit, Y level, plane table, chain, and leveling rod; also plotting, making profiles and cross-sections, and topographical drawing with pen and brush. A large share of the student's time is given to field work and practice.

"Descriptive geometry is the foundation of both the science and art of drawing. It is followed by a course of problems in shades, shadows, and perspective—mechanical drawing.

"The course of engineering consists of the subjects treated in Professor Gillespie's Roads and Railroads and Professor Wood's revision of Mahan's Civil Engineering, and of a course of lectures by the instructor

on surface and thorough drainage, on agricultural, hydraulic, and marine engineering, and a brief outline of the science and art of military engineering. The engineering drawing consists of a course of instruction in the drawing of plans, sections, elevations, and details of bridges, tunnels, canal locks, etc.

"For the above engineering course students can substitute mechanism, machinery, and machine drawing."

The catalogue for 1883-84 mentions as text-books in the school of pure mathematics: "White's or Olney's Arithmetic; Davies' Bourdon, or Olney's Algebra; Olney's Trigonometry; Bowser's or Peck's Analytical Geometry; Bowser's or Peck's Calculus; Bledsoe's Philosophy of Mathematics.

"Extra examples, illustrating the different subjects taught, are given throughout the course."

This is the first time that we find Bledsoe's Philosophy of Mathematics named as one of the text-books in a college course. According to catalogue, it was used in the third collegiate class, which completed analytic geometry and then took up "differential and integral calculus, and the philosophy of mathematics." The idea of teaching the philosophy of mathematics is certainly a good one, but the subject is hardly presented by Bledsoe in a form suitable for a young student.

In the school of applied mathematics the books given in the catalogue for 1883-84 are, Gage's Physics; Loomis's Astronomy; Davies' New Surveying; Smith's Topographical Drawing; Church's Descriptive Geometry; Wood's, or Rankine's Mechanics; Mahan's Civil Engineering; Searles's Field Engineering.

In June, 1888, a reorganization and a re-classification of the various schools took place. The work of the "school of mathematics and civil engineering" for the year 1888-89 is as follows:

#### I. MATHEMATICS.

*First class*—(Sub-Freshman): Algebra (through surds and quadratics); Geometry (three books).

*Second class*—(Freshman): Geometry, Algebra.

*Third class*—(Sophomore): Trigonometry; Graphic Algebra; Analytical Geometry.

*Fourth class*—(Junior): Calculus.

Each class is taught in sections small enough to be well handled by the instructor. Great stress is laid, throughout the course, on the written solution of original problems—the aim being to induce clearness of thought by precision in expression. Each student is required to use the level, transit, and compass, from the beginning of his Freshman to the end of his Sophomore year. On entering the Freshman class the use and adjustments of the level are explained to him. He then practices with it, at times convenient to himself, until, by running such lines as may be required of him and submitting profiles and cross-sections, he shows his ability to handle the ordinary problems of drain-

age and irrigation. The graphical problems in geometry are solved, sometimes with drawing instruments on paper, and sometimes with engineering instruments on the ground. Thus habits of accuracy are enforced early in the course by the use of instruments of precision, and an elementary knowledge of surveying afforded.

For admission to the first class the applicant is examined in arithmetic only.

The text-books now in use are as follows: Hall and Knight's *Algebra* for the Sub-Freshman class, Wentworth's *Algebra* for the Freshman class, Wentworth's *Geometry*, Wells's *Trigonometry*, Puckle's *Conic Sections* (with lectures), Newcomb's *Calculus*. The *Calculus* is taught mainly by lectures, the text-book being used as a guide. As taught at present, it is based on the idea of fluxions, demonstrated by limits, and employs the notation of Leibnitz. In pure mathematics no higher branches than the calculus have been taught at the university, except during the session 1886-87, when a class in quaternions was taught. At present agricultural students must finish trigonometry, all others analytical geometry, while the engineering students must finish calculus.

## II. CIVIL ENGINEERING.

1. (Sophomore): Descriptive Geometry; Land, City, and Mine Surveying.
2. (Junior): Stone Cutting; Astronomy.
3. (Junior): Elementary Mechanics; Analytical Mechanics.
4. (Junior): Surveys; Soundings; Maps; Profiles; Cross-sections; Estimating; Laying out Work; Engineering Materials and Methods.

The time of this class is mainly spent in practical work. It makes barometric reconnaissances; makes a map of some portion of the bed of the Tennessee River; does the field and office engineering work for a line of communications to join two selected points, etc.

5. (Senior): Analytical Mechanics; Applied Mechanics.
6. (Senior): Engineering Structures; Specifications and Contracts.
7. Post-graduate: Economics of Roads; Sewerage; Water Supply; Hydraulics; Architecture.

The department is admirably equipped with the various engineering instruments. Of the more important (such as levels, transits, sextants, aneroids, etc.) it has a number of each. It has, with great care and expense, procured instruments of the finest workmanship and latest attachments, so that its students of engineering may see how much to expect the instrument maker to contribute toward the attainment of accuracy and speed. Exercises requiring their use are continually required of every class.

The first six of these classes are required for the degree of bachelor of science in civil engineering—the *accon* for the degree of civil engineer.

At present the University of Tennessee is entering upon a career of remarkable prosperity. Like most of the higher institutions of learning in the South, it is experiencing a great revival. More thorough work and a higher standard of scholarship are everywhere perceivable.

The present prosperity of the University of Tennessee is due chiefly to the aggressive leadership of its President, Dr. C. W. Dabney, a graduate of the University of Virginia, and later of the University of Göttingen. He accepted the presidency in August, 1887, under conditions giving him great freedom to manage the institution according to his own ideas. In June, 1888, the professorships were declared vacant, and were then filled by men selected by the president. Prof. William W. Carson, who had been elected to the chair of mathematics in 1885, was now elected professor of mathematics and civil engineering. Professor Carson, a graduate of Washington and Lee, was civil engineer for a number of years. Of the other teachers of pure and applied mathematics, Prof. T. F. Burgdorff served about a dozen years in the U. S. Navy, and Prof. E. E. Gayle about an equal length of time in the U. S. Army. The three other instructors in this school are young men.

#### TULANE UNIVERSITY OF LOUISIANA.

The Tulane University came into existence as such in 1884, when, by a contract with the State of Louisiana, the administrators of the Tulane educational fund became the administrators of the University of Louisiana in perpetuity, agreeing to devote their income to its development.

The University of Louisiana had its origin in the Medical Department, which was established in 1834. This school has numbered among its professors and alumni the most distinguished medical men of Louisiana and the South. A law department was organized in 1847; and in 1878 the academic department of the University of Louisiana was opened. It existed under that name till 1884, when it was absorbed into Tulane University. Considering that the academic department of the University of Louisiana received from the State an annuity of only ten thousand dollars, it met with excellent success. A number of very earnest and well-trained young men were graduated during the six years of its existence. Its faculty consisted of only seven professors, but they were men of energy and ability. R. H. Jesse was dean of the faculty and professor of Latin. He was educated at the University of Virginia, and was a man of unusual executive ability. His individuality was strongly felt in the institution. He organized the department, taking the University of Virginia as his model. There was no curriculum or prescribed course of study. The parent or guardian had to choose, with the advice of the faculty, the branches to be pursued by the student. His cast of mind, as well as his future vocation, could thus receive due weight. In 1883 there were eight "schools." The student was required to attend at least three, but he was discouraged from electing more than four, in order to prevent superficial work.

The school of mathematics was in charge of J. L. Cross, the professor of mathematics. Professor Cross was, before the War, a student at the Virginia Military Institute, and a pupil of Prof. Francis H. Smith. The school of mathematics was organized into three regular

classes, the Junior, Intermediate, and Senior. During part of the time it was found necessary to establish also an introductory class for students deficient in preliminary studies. The requirements for admission to the Junior class were a knowledge of arithmetic and Loomis's Elements of Algebra. The Junior class studied Loomis's Treatise on Algebra, and Loomis's (later Wentworth's) Plane and Solid Geometry. The Intermediate class was taught Loomis's Plane and Spherical Trigonometry, and Loomis's Analytical Geometry. The Senior class completed the course in mathematics by the study of Church's Descriptive Geometry, and Loomis's Differential and Integral Calculus. Professor Cross is, we believe, the first teacher who ever carried classes in New Orleans through the calculus.

Very efficient work was done by students in the school of physics. This was in charge of Prof. Brown Ayres. Professor Ayres received his general education at the Washington and Lee University, and his training as a specialist at the Stevens Institute and the Johns Hopkins University. At the last institution he was honored with a fellowship in physics. He is a true lover of science, and, with great proficiency in the theoretical and mathematical parts of his subject, combines great mechanical ingenuity and skill. In his prelections on text-books he is extremely clear, and his experiments are always very successful and interesting. His great aim is to awaken in students a genuine love for pure science. In his school students had frequent opportunities of applying their knowledge of pure mathematics to physical problems. The theory of the combination of observations by the method of least squares was a study in his course. During several years he taught also analytical mechanics, using the work of De Volson Wood.

In 1884 the University of Louisiana was absorbed into the Tulane University of Louisiana. Paul Tulane, who had been in business in New Orleans for fifty years, donated the greater part of his large fortune for higher education in New Orleans. Owing to his munificence, Tulane University has the good fortune of being free from those pecuniary embarrassments with which the University of Louisiana had always to contend. Under the presidency of Col. William Preston Johnston, an educator of great ability and wide reputation, the courses of study as they had existed in the University of Louisiana were reorganized.\* Not trusting in the ability of immature students, or even of parents unaccustomed to consider the due proportions and sequence of studies, to properly formulate their own ideals in education, Tulane College offered a series of six equivalent curricula with prescribed branches, all leading to the degree of bachelor of arts. These six courses of study were denominated, respectively, the Classical, Literary, Mathematical, Natural Science, Commercial, and Mechanical Courses. In the

\* For further information regarding the plan and workings of Tulane University see President Johnston's address on "Education in Louisiana," before the National Educational Convention, Topeka, Kan., July 15, 1886.

spring of 1880, the commercial course was discontinued, and the mathematical course had its name changed to physical science course.

All the professors of the University of Louisiana continued to hold their respective chairs under the new régime. Several new professors were added to the faculty.

The mathematical requirements for admission to Tulane College are a knowledge of algebra to quadratics and of plane geometry. The course in mathematics is the same for all Freshmen. After completing the algebra they take up solid geometry, plane and spherical trigonometry, surveying and leveling, and navigation. In the Sophomore year, classical and literary students pursue analytical geometry, three hours per week, before Christmas. This completes the mathematics for students in those two courses. In the three other courses mathematics is pursued six hours per week throughout the year, and consists in the study of analytical geometry and differential calculus. In the first half of the Junior year, students in the physical science course and mechanical course pursue the study of integral calculus. These branches are taught by Professor Cross from Loomis's text-books, excepting that Wentworth's book is used in geometry.

The mathematical teaching has, thus far, been strictly confined to the ordinary college branches. No work of university grade, as distinguished from college grade, has yet been attempted. "The end kept always in view is to impress the principles of mathematical truth clearly and deeply on the mind, by careful explanations, by daily examinations, and by constant application of these principles by the students themselves to numerous examples taken from the text-books and from other sources."\* Professor Cross believes in making a clear presentation to the student of the principles of mathematics, without applying them to any great number of special cases. In his opinion, much valuable time is wasted in the solution of problems. If a student can give, for instance, the general solution of a quadratic equation, then there is no need of solving dozens of special exercises under this head. In geometry careful attention is given to the correct understanding of the demonstrations given in the book, but little or no effort is made to solve original exercises. In the class-room Professor Cross preserves strict discipline and is earnest in the discharge of his duties. When the routine work of the day is over, his mind finds relaxation and rest in a good game of chess or checkers.

Students in the mechanical and physical science courses study analytical mechanics under Professor Ayres six hours per week during the second half of the Junior year. This subject has been exceedingly well taught. The text-book used heretofore in connection with lectures has been Wood's *Analytical Mechanics*. This is a good text-book, inasmuch as the subject is taken up more or less inductively, and a large

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\* Catalogue of the Tulane University of Louisiana, 1884-85, p. 46.

number of special and well-graded problems is given to be worked by the student. Wood makes extensive use of the calculus in his *Analytical Mechanics*. The experience has been at this institution, as also at others, that students who have gone through Loomis's *Calculus* are hardly well enough prepared in that branch to pursue with ease a course in analytical mechanics. Some important parts of the integral calculus, particularly definite integrals, receive exceedingly meager treatment in this book. The course in analytical mechanics serves to impress more deeply and lastingly the principles of the calculus and displays to the student its wonderful power in the solution of all sorts of mechanical problems. This year (1888-89) Michie's *Analytical Mechanics* will be used as a text-book by Professor Ayres. It contains a beautiful chapter on graphical statics. In the Senior year students in the mechanical course take up the subject of applied mechanics. Professor Ayres is using, this year, Cotterill's *Applied Mechanics*, a standard work of great merit.

In 1883 a very fine collection of physical apparatus was purchased by the university at a great expense. In optics the collection is excellent. The university is fortunate in having a physicist who knows how to make use of delicate instruments. Since the above date Professor Ayres has devoted much of his time and energy toward building up a good laboratory. A practical physical laboratory is somewhat of a novelty in the South. Tulane University offers now as good and efficient courses in experimental physics to students of college grade as any university in the country.

Since Tulane University is dependent for its supply of students chiefly upon its own high school, wise provisions have been made for more thorough instruction in that department. With Professor Ashley D. Hurt as head-master the high school has been prosperous and thorough in its work. Both teachers and pupils are working with great earnestness, and it is gratifying to know that the number of students entering the college after graduating from the high school is decidedly on the increase.

The New Orleans Academy of Sciences holds its meetings at the Tulane University. The professors of the university are its leading members. There is a general meeting once every month for all members of the academy. In addition to this, there are section meetings. "Section A," the mathematical and physical section, meets the second Tuesday of every month. Professor Ayres has been the leading spirit in this section, and has contributed many an interesting paper on physics and mathematics. Two years ago the academy began publishing an annual volume, containing the principal papers read during the year. The publication for the year 1887-88 contains an article on the "History of Finite Series," and an interesting article by Professor Ayres on "Languages and Phonology." During the last two years the

academy has been in a flourishing condition, and the quality of the work done has been improving continually.

In the fall of 1887 the H. Sophie Newcomb Memorial College for Young Women was opened as a branch of Tulane University. It was founded on an endowment made by Mrs. J. L. Newcomb, of New York. This institution is under the able management of President Brandt V. B. Dixon, who is also professor of metaphysics and mental science at the Tulane University. It is the aim to put the Newcomb College on an equal footing with the Tulane College. Young women will thus have the same facilities for higher education in New Orleans that young men have.

The first year (1887-88) was a year of organization. Many features of the school were of necessity only tentative. The great obstacle to high scholarship is the lack of proper preparation on the part of applicants. For this reason it has been necessary to establish a preparatory department. The Newcomb College offers four parallel and equivalent courses of study—the Classical, Literary, Scientific, and Industrial. In the two preparatory years, higher arithmetic and algebra are studied. It is the intention to introduce also a course on inventional geometry. The first year in college is devoted to geometry, the second to the completion of algebra and to trigonometry. To students taking the scientific and industrial courses, analytical geometry is offered in the Junior year, and calculus and astronomy in the Senior year. During the first year in the history of the college there were classes in algebra, geometry, and trigonometry. Wentworth's text-books were used. In the preparatory department there were two classes, one in arithmetic and algebra, and the other in algebra. The latter class did faithful and thorough work in Wentworth's Complete Algebra through quadratic equations. This division did as good work as any class of young men which the professor has taught. If not always quite as penetrating in the solution of problems as young men, the young ladies worked more faithfully and perseveringly. The lowest class of college grade finished plane geometry and then reviewed algebra as far as logarithms. The work in geometry was quite satisfactory. A great effort was made to induce students to solve original exercises. While paralogisms were very frequent, especially at first, the efforts were not without some success. The solving of original exercises in geometry is too much neglected in our schools; nor are our text-books always satisfactory on this subject. In the opinion of the writer, the number of exercises should be greatly increased, and very great care should be taken to either omit the difficult exercises or give "hints" as to their mode of solution. Students should not be permitted to get disheartened in this sort of work. "The inventive power grows best in the sunshine of encouragement." Wentworth has greatly improved his text-book in his revised edition of 1888, by the insertion of seven hundred additional exercises.



The professor has found that the interest which pupils take in their studies may be increased if the solution of problems and the cold logic of geometrical demonstrations are interspersed by historical remarks and anecdotes. A class in arithmetic will be pleased to hear about the Hindoos and their invention of the "Arabic notation;" they will marvel at the thousands of years which elapsed before people had even thought of introducing into the numeral notation that Columbus egg, the zero; they will find it astounding that it should have taken so long to *invent* a notation which they themselves can now *learn* in a few weeks. The class will take an interest in the history of decimal fractions and the various notations that were used once in place of our decimal point. After the pupils have learned how to bisect a given angle, surprise them by telling of the many futile attempts which have been made to solve by elementary geometry the apparently very simple problem of the trisection of an angle. When they know how to construct a square whose area is double the area of a given square, tell them about the duplication of the cube—how the wrath of Apollo could be appeased only by the construction of a cubical altar double the given altar, and how mathematicians long wrestled with this problem. After the class have exhausted their energies on the theorem of the right angled triangle, tell them something about its discoverer—how Pythagoras, jubilant over his great accomplishment, [is said to have] sacrificed a hecatomb to the Muses who inspired him. When the value of mathematical training is called in question, quote the inscription over the entrance into the academy of Plato, the philosopher: "Let no one who is unacquainted with geometry enter here." To more advanced students the history of mathematics becomes instructive and profitable as well as interesting. It seems to me that students in analytical geometry should know something of Descartes, who originated this branch of geometry, that, taking up differential and integral calculus, they should become familiar with the parts which Newton, Leibnitz, and Lagrange played in creating the transcendental analysis. No one can claim to have a fair knowledge of this subject who knows not something about the three methods taught by these great analysts. In his historical talk it is possible for the teacher to make it plain to the student that mathematics is not a dead science in which no new discoveries are or can be made, but that it is a living science in which racing progress is being made all the time.

#### UNIVERSITY OF TEXAS.

The University of Texas opened its doors to students for the first time in 1827. The first professor of mathematics was Leroy Brown, who served one year. He was succeeded by G. B. Halsted as professor of pure and applied mathematics. At the same time with Halsted, A. V. Lee was created assistant instructor in mathematics. He was advanced to the position of assistant professor of applied mathematics in 1855.

Prof. G. B. Halsted was graduated in Princeton in 1875, and received the degree of doctor of philosophy at the Johns Hopkins University in 1879, where he had studied for two years under Professor Sylvester, and had held a fellowship in mathematics. Before taking his degree he spent some time in Berlin, prosecuting mathematical studies. In 1878 he was appointed tutor in mathematics at Princeton College, and three years later instructor in post-graduate mathematics.

Dr. Halsted has established a wide reputation as a mathematician and logician. He has contributed to the American Journal of Mathematics, the Annals of Mathematics, the Mathematical Magazine, the English Philosophical Magazine, and several other scientific journals. He has published two books, *An Elementary Treatise on Mensuration* (Boston, 1881), and *The Elements of Geometry* (New York, 1885). His books and scientific articles have been favorably reviewed in leading foreign journals. His *Metrical Geometry* (mensuration) is the best book of its kind that has been published in this country. It contains many new and interesting features. Of these we would mention his treatment of solid angles (the words *steregon* and *steradian*, now quite generally adopted, were manufactured by him and first used here) and his discussion of the prismatoid, deriving a general formula for its volume. He introduced a distinction between the words *sphere* and *globe* (making one to mean a surface and the other a solid), which is worthy of general adoption.

The distinguishing feature of the two works of Halsted is their scientific rigor. Teachers who favor a rigid treatment of geometry will find it in his *Elements*. The book rejects the "directional method" as wholly unscientific; also the use of the word "distance" as a fundamental geometric concept. The word *sect*, first used in his *Mensuration*, is introduced here, meaning "the part of a line between two definite points." Many teachers do not endorse the introduction of this new technical term in elementary geometry, as they think that there is no particular call for it. The author is certainly right in protesting against the use of the word "distance" in two different senses. That there has really been a want for some of the other new technical terms first introduced by Halsted is evident by the fact that they have been adopted in standard works, such as the *Encyclopædia Britannica*.

Like his *Mensuration*, his *Elements of Geometry* possesses many novelties. In his book on Rectangles he introduces a strictly geometric algebra, where  $a$  and  $b$  mean sects, and, by definition,  $ab$  means their rectangle, thus avoiding measurement and the use of numbers. Ratio and proportion are strictly treated, but without limits. The book on two-dimensional spherics gives a novel method of treating spherics. His demonstration of the two-term prismoidal formula has been translated into French by the editors of a mathematical journal published in Belgium. Halsted is the first writer in this country to preface a geometry by a preliminary chapter on logic. Judged from a scientific point

of view, we believe Halsted's Geometry to be the peer of any geometry published in America.

Professor Lane has contributed one article on "Roulettes" to the *American Journal of Mathematics*, and has written a neat little book on *Adjustments of the Compass, Transit and Level*. Professor Lane taught chiefly the applied mathematics, i. e., mathematics applied to engineering, and reached good results in his work. In June, 1888, he resigned his professorship, and his place was filled by the selection of a native Texan, T. U. Taylor. Professor Taylor is a graduate of the University of Virginia, and before accepting the present position was professor of pure and applied mathematics in the Miller Manual Labor School of Virginia.

The mathematical requirements for admission have been from the beginning the same as they are now, except that Prof. L. Brown examined students in Wentworth's Geometry instead of Halsted's. As stated in the catalogue of 1887-88, the terms for admission are as follows: "Arithmetic, including proportion, decimals, interest, discount, and the metric system; algebra, including theory of exponents, radicals, simple and quadratic equations; and the elements of plane geometry (corresponding to the first six books of Halsted's Geometry).

"Passing these examinations, a student will be admitted to the Freshman class in the course of science, or to the Junior class of the law department."

Great efforts are being made to cause the high schools in the State to work in line with the university. High schools desiring the privilege of sending their graduates to the university without examination are inspected by committees from the faculty of the university, and if the work of a school be found satisfactory the school is "approved." Thus far the number of irregular students in the academical department of the university has been large, but as the institution grows older, the students entering with a view of taking a four-years' course and graduating will doubtless rapidly increase.

During the first year of the university there were, naturally, no classes formed in the higher mathematics. At the beginning of the second year, in addition to the lower classes, there was a Sophomore class in analytic geometry, and a Junior class in differential and integral calculus. At the beginning of the third year, in addition to these, there was a Senior class in quaternions, and since then there have always been Freshman, Sophomore, Junior, and Senior classes in mathematics.

At the beginning, Wentworth's Algebra and Geometry were used by Professor Brown. When Professor Halsted entered upon his duties at the university he "found that the lack of rigor in Wentworth's Geometry was so exasperating" that he "could not continue to use it with comfort or a clear conscience," and so he put in form for the printer his own manuscript on geometry. His geometry has been used since its

issue, supplemented by Halsted's *Mensuration*. The analytic geometry used is Puckle's *Conic Sections*. Until the present year (1888-89) By-erly's *Calculus* has been taught. Post-graduate courses in mathematics are now offered to students.

The present mathematical course is as follows (catalogue 1887-88):

The *Freshman class* will study algebra, solid geometry, spherics, mensuration, plane and spherical trigonometry, with their applications to surveying, navigation, etc.

The *Sophomore class* will study analytical geometry, graphic algebra, and theory of equations.

The *Junior class* will study analytical geometry of three dimensions, differential and integral calculus. This course of study will embrace the applications of the calculus to mechanics and physics.

The *Senior class* will study determinants, quaternions, invariants, and quantities.

In the higher classes will be discussed the history and logical structure of the mathematical sciences, and the logical theory of the calculus, the theory of limits, and the infinitesimal method.

*Text-books.*—Wentworth's *Complete Algebra*; Halsted's *Geometry* (John Wiley & Sons, New York); Halsted's *Mensuration*, 3d Ed. (Ginn & Co.); Wentworth's *Trigonometry, Surveying, and Navigation*; Graphic Algebra, by Phillips & Beebe; Puckle's *Conic Sections*, 5th Ed.; Smith's *Solid Geometry*; Newcomb's *Differential and Integral Calculus*; *Theory of Equations*, by Burnside and Panton, 2d Ed.; Muir's *Determinants*; Scott's *Determinants*; Salmon's *Modern Higher Algebra*, 4th Ed.; Hardy's *Quaternions*.

Engineering students are required to take the four-years' course; science students, the studies for the first three years; arts students, those of the first two years; and letters students, those of the first year.

Two post-graduate courses are offered:

I. A course preparatory to original investigation in the objective sciences. This will include infinitesimal calculus, the method of least squares, kinematic, linkage, differential equations, the calculus of finite differences.

*Text books.*—Williamson's *Differential Calculus*, Williamson's *Integral Calculus*, Clifford's *Kinematic*, Forsyth's *Differential Equations*, Boole's *Differential Equations*, Boole's *Calculus of Finite Differences*, Merriman's *Method of Least Squares*.

II. A course preparatory to original investigation in the subjective sciences. This will include projective geometry, the theory of numbers, the algebra of logic, the theory of probability, non-Euclidian geometry.

*Text-books.*—Cremona's *Projective Geometry*; Lejeune Dirichlet's *Zahlentheorie*, 3d Ed.; Macfarlane's *Algebra of Logic*; Boole's *Laws of Thought*; Todhunter's *History of the Theory of Probability*; Frischauf's *Absolute Geometrie*.

The catalogue for 1887-88 gives one student taking post-graduate studies in mathematics.

The university is open to both sexes. "A number of young ladies still show that they are capable of mastering even the abstruse modern developments of this oldest of the sciences." (Professor Halsted, June, 1888.)

#### WASHINGTON UNIVERSITY.

Up to the date of writing we have not been able to secure the information desirable for a sketch of the mathematical teaching at this university, but an excellent biographical notice of Professor William

Chauvenet, the first professor of mathematics at Washington University, has been written for us by his son, Regis Chauvenet, now president of the State School of Mines, at Golden, Colo. Professor William Chauvenet ranks among the coryphæi of science in America. He and Benjamin Peirce have done more for the advancement of mathematical and astronomical science, and for the *raising to a higher level* of the instruction in these subjects, than any other two Americans. It is our wish, on that account, to place before the reader a somewhat full sketch of the life and works of Professor William Chauvenet. The biographical notice above referred to is as follows:

"William Marc Chauvenet, father of the subject of this sketch, was born at Narbonne, France, in 1790, and came to the United States in 1816. He was the youngest of four brothers, another of whom also came to this country but has left no descendants. William Marc was a man of education and culture, versed in several languages, and a constant reader. He came to America, however, in connection with a manufacturing enterprise which had its headquarters in New York, with a branch at Boston. The latter department was under Mr. Chauvenet's charge, and here he married, in 1819, Miss Mary B. Kerr, of Roxbury. This was before a heavy defalcation in the New York house, which broke up the enterprise so badly that all investments in it proved to be total losses. Mr. Chauvenet having an idea that rural life would suit his taste, bought a small farm close to Milford, Pike County, Pa., and it was here that his only child, William Chauvenet, was born, May 24, 1820.

"By the advice of friends Mr. Chauvenet soon gave up his attempt at farming, and settled in Philadelphia, where his son grew to manhood. His rapid progress at school attracted such attention from his instructors, especially in mathematics, that his father easily yielded to their advice, and sent him to Yale College, where he graduated in 1840, '*facile princeps*' in mathematics, and high in standing in all other branches. The honorary societies, 'Phi Delta Kappa' and 'Chi Delta Theta,' denoting respectively the fifteen of highest standing and the fifteen best writers of the class, each claimed him as a member.

"Upon his return to his home he was, after a brief incumbency in a subordinate position, appointed professor of mathematics in the Navy. Late in 1841 he married Miss Catherine Hemple, of Philadelphia. Shortly after this he served a brief term on a United States vessel, as instructor to midshipmen, but did not go upon a foreign cruise, and was soon detached to the 'Naval Asylum,' then situated at Philadelphia. Here midshipmen were sent at that time, to receive instruction and examinations, principally in mathematics and the theory of navigation. The young professor was struck with the imperfections in the education of naval officers, and it was very largely through his efforts, aided by such influences as he could bring to bear on the matter, that a commission was appointed to draft a plan for a fixed 'Naval Academy,' corre-

sponding to the Military Academy at West Point. Six naval officers constituted this commission, Professor Chauvenet being of the number. The appointment of so young a man (he was but twenty-four at the time) on a commission of such importance indicates what must have been his record, and the impression he made upon his seniors in years and rank.

"The Naval Academy was formally called into existence in the year 1845, being located at Annapolis, Md. Professor Chauvenet was appointed to the chair of mathematics, and resided at the academy until his resignation from the Navy in 1859.

"It was not long after this change of residence that he began to plan his work on trigonometry, which was published in 1850. Its title, 'A Treatise on Plane and Spherical Trigonometry,' partly indicated that it was not a students' class-book merely, but that it took up most of the more advanced applications of the subject. It soon assumed the position it still retains as the standard reference work in its line.

"Some time before this publication, Professor Chauvenet had persuaded his father to retire from business and accept a position at the academy. He came as instructor in the French language, and remained at his post until his death in 1855.

"It having been decided to erect an astronomical observatory at the academy, Professor Chauvenet was made professor of astronomy and put in charge of the observatory. As he became more and more interested in his work, the idea of his next treatise, 'Spherical and Practical Astronomy,' grew upon him, and, just previous to his resignation, had assumed such form that he issued a prospectus for its publication as a subscription work. This was never carried out.

"In 1859 he was notified that his application for the professorship of mathematics at Yale College would be followed by his election to that position. Almost simultaneously with this came a call to St. Louis, Mo., where he was offered the same chair in the then newly-established Washington University. After much deliberation he accepted the latter, and removed with his family (including at that time his mother) to St. Louis, in the fall of 1859.

"Chancellor Hoyt, who was at the head of the 'Washington' at this time, died early in the 'sixties,' and Professor Chauvenet was elected to the vacancy. He still continued his duties as professor of mathematics, however, and now resumed his work on the 'Astronomy.' The risks of publication were great, and his means did not enable him to guarantee the publishers against loss. The Civil War was in progress, and the time seemed inopportune for such an undertaking. It was to the liberality of certain friends, chiefly to the initiative of Mr. (afterward Judge) Thomas T. Gantt, of the St. Louis bar, that a guarantee fund was raised, sufficient in the opinion of the publishers to prevent any loss to them. The work, in two octavo volumes, was published in 1863.

"Few works of a scientific nature, by American authors, have been

received with such universal favor, by those competent to judge of its merits, as was this. Its reputation was quite as great in Europe as here, while of course it is not (as it was never intended to be) a treatise much known outside of scientific, and more especially astronomical, circles. Its scope, and the rigorous methods adopted, are sufficiently indicated in the author's preface. It retains to-day its standard character, as fully as when this was first recognized by the scientific world upon its publication.

"Professor Chauvenet's mother died in St. Louis, not long after the appearance of the *Astronomy*, and it was but a few months later that the first symptoms of the disease that proved finally fatal to him, made their appearance. Partial recovery and resumption of his duties was followed by a long period of alternating hopes and fears, during which time he tried in vain different parts of the United States, from South Carolina to Minnesota. During this illness he worked at his only elementary publication, the '*Geometry*,' which he undertook, partly because he had long thought that the popular texts of the day were marked by too strict an adherence to strictly 'Euclidian' methods, and partly because he wished to provide an income for his family, by the publication of a text for which he had reason to suppose there would be a larger sale than was possible with advanced treatises. The publication of this work shortly antedated his death, which occurred at St. Paul, Minn., December 13, 1870.

"Professor Chauvenet left, so to speak, two distinct impressions behind him. By far the larger circle, in numbers, of those who knew him, were of those to whom his scientific attainments, though known, were as traditions merely, since they were in a field whose extent was to them only a matter of vague conjecture. To these he left the impression of a man of wide and varied culture, and keen critical taste. Probably few scientists of distinction were more keenly interested in lines outside of their own specialties. He was not only a critic in music, but to his latest day a pianist of no mean ability, always expressing a preference, in his own playing, for the works of Beethoven, which he rendered with an interpretation which never failed to excite the admiration of musicians whose execution surpassed his own. His knowledge of English literature was extensive, but he read and re-read a few authors, at least in the latter part of his life, and his great familiarity with many of these gave point to the old adage, 'fear the man of few books,' though perhaps not in the sense in which these words were originally intended. He was a ready writer, and contributed at times reviews, partly scientific, to various journals. His style was clear and unaffected, while, in the review of a pretentious or ignorant author, he had the gift of a delicate sarcasm, so light at times as only to be visible to one reading between the lines. For other pretenders he could drop this mask, and write with severity; but only twice in his life, to the knowledge of the present writer, did he ever do so. In addition to his more important writings,

he was the author of a 'Lunar Method,' still used in the Navy, and invented a device called the 'great circle protractor,' by which the navigator is enabled (knowing his position) to lay down his course on a 'great circle' of the globe, without further calculation. This invention was purchased by the United States Government not long after the close of the Civil War.

"Professor Chauvenet's scientific reputation needs little comment on the part of the present writer. He was one of a group of scientists in his own or cognate lines, who were the first to secure recognition abroad, as well as at home, for the position of the exact sciences in the United States. Among his more intimate scientific friends were Benjamin Peirce and Wolcott Gibbs (Harvard), Dr. B. A. Gould, and many others whose names are as household words in the history of scientific progress in this country. At the formation of the National Academy of Sciences he was one of the prominent members. But while his scientific reputation will outlast his personal memory, it is doubtful if to those who knew him, even of his scientific associates, it will ever be as present as his strong personal attractiveness, the result at once of an easy and varied culture, and of a simple dignity of character, which impressed alike his family, his friends, and his pupils. His family, consisting at the time of his death of his wife, four sons, and a daughter, are all still living (1889)."

The only mathematical book written by Chauvenet and not mentioned in the above sketch is a little book entitled *Binomial Theorem and Logarithms*, published in 1843 for the use of midshipmen at the Naval School, Philadelphia.

As regards the quality of Professor Chauvenet's books, Prof. T. H. Safford, of Williams College, says: "This excellent man and lucid writer was admirably adapted to promote mathematical study in this country. His father, a Frenchman of much culture, trained him very thoroughly in the knowledge of the French language, even in its niceties. They habitually corresponded in that language; and the son was enabled to study the mathematical writings of his ancestral country in a way which enabled him to reproduce in English their ease and grace of style, as well as their matter. In these respects his works are far more attractive than those of ordinary English writers; his *Trigonometry* is much the best work on the subject which I know of in any language; his *Spherical and Practical Astronomy* is frequently quoted by eminent continental astronomers; and his *Geometry* has raised the standard of our ordinary text-books, of which it is by far the best existing."<sup>\*</sup>

Chauvenet's books, especially his *Geometry*, have been used in the best of our schools. Recently a revised edition of his *Geometry* has been brought out by Professor Byerly, of Harvard. Among the chief modifications made by him are the following: (1) The "exercises," which

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<sup>\*</sup> *Mathematical Teaching*, by Prof. T. H. Safford, 1887, p. 9.



in the original are at the end of the book, are most of them placed in direct connection with the theorems which they serve to illustrate. (2) The admirable little chapter in the original edition on "Modern Geometry" is omitted. (3) The "directional method" is introduced. The first is, no doubt, a change for the better; the second and third are, we think, to be regretted. It seems to us that the day has come when a college course should set aside some little time to the study of modern methods in elementary geometry, and not confine itself to the ancient. The introduction of the "directional method," in our opinion, robs the book of some of that admirable rigor for which the original work of Chauvenet is so justly celebrated.

His Trigonometry and Astronomy are the first American works to introduce the consideration of the *general spherical triangle*, in which the six parts of the triangle are not subjected to the condition that they shall each be less than  $180^\circ$ , but may have any values less than  $360^\circ$ . This feature is mainly due to Gauss. The methods of investigation followed in these two books are chiefly those of the German school, of which Bessel was the head.

#### UNIVERSITY OF MICHIGAN.\*

The University of Michigan opened in 1841. In its organization Prussian ideas predominated. But the régime which existed during the first ten years in the history of the university did not prove efficient. A re-organization was therefore effected in 1852. The board of regents were, from that time on, rendered independent of the Legislature by intrusting their election to the people. The German method of governing the faculty by an annual president elected by that body was abandoned in 1852, and it was henceforth the duty of the board of regents to appoint a chancellor for the university.

The first appointment to a professorship at the University of Michigan was that of George Palmer Williams, in 1841. He was first assigned to the chair of ancient languages. On the work of this department, however, he did not enter, but exchanged it for that of mathematics and natural philosophy.

Professor Williams was born in Woodstock, Vt., in 1802. After graduating at the University of Vermont he studied theology at Andover, then became tutor at Kenyon College, and later professor of languages in the Western University of Pennsylvania. Thence he returned to Kenyon College, where he remained until 1837, when he entered upon the services of the board of regents of the University of Michigan, as principal of the Pontiac Branch.

At the University of Michigan he was professor of mathematics and natural philosophy until 1851, professor of mathematics from 1854 to

\*For part of the information herein contained we are indebted to Prof. W. W. Beman, of Ann Arbor. The writer is also under obligation to Charles E. Lowrey, Ph. D., for interesting oral communications.

1863, and professor of physics from 1863 to 1875. Williams was a man of culture and refinement, and understood well the branches which he attempted to teach. As an instructor he lacked thoroughness. "Though he never felt himself called upon to force the reluctant mind into a thorough understanding of that for which it had no liking, he helped those who desired to study in attaining to the established standard, and, in a private way, he loved to aid those who desired his help in transcending that limit. Astronomy, though not nominally in his professorship, he taught until the revision of the course in 1854, and a great enthusiasm was annually awakened among the students as they came to the calculation of eclipses."<sup>\*</sup>

The mathematical requirements for admission were, in 1847, arithmetic, and algebra through simple equations. The college course for that year included algebra, geometry, conic sections, plane and spherical geometry, and calculus. In 1848 it was the same, save calculus or analytical geometry, and in 1849 calculus and analytical geometry. The text-books were those of Professor Davies, of West Point.

Before its reorganization, in 1852, "the institution had flagged somewhat in popular interest; the number of its students had fallen off; a more vigorous and aggressive leadership was imperatively needed."<sup>†</sup> In the year just named, Dr. Henry P. Tappan, of New York, was inaugurated first chancellor. His connection with the university marks a new era in its history. During the reconstruction, German ideals were constantly kept in view. He thoroughly understood the workings of German universities and was a recognized champion among us of university education, as distinguished from college education. In the first catalogue (1852-53) issued by him, we read: "An institution can not deserve the name of a university which does not aim, in all the material of learning, in the professorships which it establishes, and in the whole scope of its provisions, to make it possible for every student to study what he pleases and to any extent he pleases. It is proposed, therefore, at as early a day as practicable, to open courses of lectures for those who have graduated at this or other institutions, and for those who in other ways have made such preparation as may enable them to attend upon them with advantage. These lectures, in accordance with the educational systems of Germany and France, will form the proper development of the university, in distinction to the college or gymnasium now in operation." The university system has been growing at Ann Arbor, though at first very slowly.

The first fruits of the plan laid down in the catalogue just named was the appointment to the chair of astronomy, in 1854, of Dr. Francis Brünnow, of Leipsic, a favorite pupil and assistant of the celebrated astronomer Encke. Brünnow remained at the university until 1863, when he resigned to take charge of the Dudley Observatory. Later, he

<sup>\*</sup> University of Michigan, by Andrew T. Brook, 1875, p. 298.

<sup>†</sup> The Study of History in American Colleges, by Herbert B. Adams, p. 98.

became director of the Royal Observatory in Dublin, Ireland. Under his able management the observatory at the University of Michigan (called the Detroit Observatory, in recognition of the liberality of citizens of Detroit who founded it) soon rose to high rank. Besides the "Tables of Flora" and the "Tables of Victoria," published at Ann Arbor, Dr. Brinnow contributed to science his large work on Spherical Astronomy and many papers on astronomical subjects. But the influence of its renowned scholar was felt also in the department of pure mathematics. It is he who gave the university its start mathematically. When Professor Olney became a member of the faculty, then the university had already made a respectable beginning in the study of exact science.

The year 1856 marks the earliest dawn of the "elective system" at the University of Michigan. One of the elective studies offered to Seniors in that year was astronomy. Professor Brinnow lectured on this subject to an elective class of one—James C. Watson.\* With reference to this class Dr. White happily said, that "that was the best audience that any professor in Michigan University ever had." Brinnow, with his pupil Watson, reminds us of Gauss, of Göttingen, who lectured at that great university to less than half a dozen students, while Thibaut, a mathematician of no scientific standing, presented the elements of mathematics to audiences of hundreds. "If I had the choice," said Hankel, "I should prefer being Gauss to Thibaut." If we had the choice, we should prefer being a Brinnow lecturing to one or two Watsons, rather than being very ordinary teachers lecturing to large classes of easy-going students.

Watson was born in upper Canada in 1833. He early exhibited extraordinary mental power and activity. When the lad was twelve his parents were anxiously casting about to secure for him the privileges of a liberal education. They looked eastward to Toronto and westward to Michigan. Being in humble circumstances, they chose the latter place, *because education there was free*. Young Watson entered at the Ann Arbor High School, but after an attendance of one day and a half he was graduated, for it was found that in the sciences he was altogether beyond anything which his teachers had thought of. The poverty of his parents made it necessary for him to partly rely upon his own support. At this time the future astronomer could be seen going about sawing wood for boys in college, while his mother took in washing to support herself and boy. At the university Watson displayed as much talent for languages as he did for mathematics. The story goes that he decided between mathematics and Greek, as his specialty, by throwing a penny. "There slips the penny, for which?" A noticeable exploit in the Junior year was his reading the entire *Mécanique*

\* Our remarks on Professor Watson are drawn chiefly from an address delivered by Prof. J. C. Freeman, of the University of Wisconsin, and printed in the *Ægis*, Vol. I, No. 37, June 24, 1887.

Céleste of La Place. In the Senior year he took the course of lectures under Brünnow, spoken of above.

While yet very young, Watson contributed numerous astronomical and mathematical articles to foreign journals. He published in 1867, at the age of twenty-nine, his great work on Theoretical Astronomy. Its design appears from these prefatory words: "Having carefully read the works of the great masters, my plan was to prepare a complete work on the subject, commencing with the fundamental principles of dynamics and systematically treating, from one point of view, all the problems presented." The book gives a systematic derivation of the formulæ for calculating the geocentric and heliocentric places, and determining orbits, and for computing special perturbations, including also the method of least squares, together with a collection of auxiliary tables, etc. The work was translated into continental languages and became the text-book in many observatories in Germany, France, and England.

When Brünnow left Ann Arbor, in 1863, Watson became his successor. Watson discovered a considerable number of Asteroids. Twenty-three times, says Professor Freeman, he knew the joy felt by

"Some watcher of the skies  
When a new planet swims into his ken."

He was led to believe that there existed between Mercury and the sun a planet hitherto unknown. During his observation of the eclipse in 1878, at Denver, he caught sight, as he thought, of this new planet.

Watson's genius made the University of Michigan known in scientific circles throughout the world. His mind was pre-eminently fitted for his specialty. With a powerful memory and great mechanical genius, he combined the ability to grasp abstruse problems by a kind of intuition. He was a man of wonderful activity. Says Professor Freeman: "There was a tireless energy in the man that impressed every beholder. Some of you recall the feeling you had when Grant or Sherman joined the army in the field, or when you saw Sheridan making his last mile from Winchester to Cedar Creek. Something of the same inspiration Watson gave his associates."

During his directorship of the observatory, Watson generally delivered every year to the student community a course of popular lectures, but was otherwise relieved from further duties of giving instruction, excepting to pupils intending to make astronomy their specialty. He had little patience with the average boy, but his interest in his special students never flagged. He took great pains to secure for them suitable positions. Old pupils of his may be found holding responsible positions in the U. S. Navy, Patent Office, and Coast Survey. His two most favorite pupils were George C. Comstock and John Martin Schaeberly. Watson took the former with him when he left Ann Arbor, in 1879, to take charge of the Washburn Observatory at the University of Wisconsin. Mr. Schaeberly remained at the Detroit Observatory until

1888, when he accepted a place at the Lick Observatory. He was succeeded at Ann Arbor by W. W. Campbell. After Watson left Ann Arbor, Prof. Mark W. Harrington became director of the observatory there.

During his first years after graduation, Watson taught, besides astronomy, mathematics and physics. Thus, from 1859 to 1860 he was professor of astronomy and instructor in mathematics; from 1860 to 1863, instructor in physics and mathematics. Other young instructors in mathematics of this time were W. P. Trowbridge, 1856 to 1857, a graduate of the U. S. Military Academy; and John Emory Clark, 1857 to 1859. Both of them became connected, later, with Yale College, the former as professor of mechanical engineering, the latter as professor of mathematics. These young men did much, no doubt, to supply that thoroughness which was wanting in the teaching of Professor Williams, the regular professor of mathematics. A beneficial stimulus to the study of pure mathematics was exerted by the department of engineering; for good work in that department was impossible without good preliminary instruction in pure mathematics. Connected with the department of civil engineering, from 1855 to 1857, was William Guy Peck, a graduate of West Point. He was succeeded by De Volson Wood, who had just graduated at the Rensselaer Polytechnic Institute. After leaving the University of Michigan, in 1872, Wood became professor of mathematics and mechanics in the Stevens Institute of Technology. He is the author of *Resistance of Materials, Roofs and Bridges, Elementary Mechanics, Analytical Mechanics*, revised edition of Mahan's *Civil Engineering*, and *Elements of Coördinate Geometry* (including Cartesian Geometry, Quaternions, and Modern Geometry). Professor Wood's text-books contain numerous examples to be worked by the student. These books possess many good features, and have been used quite extensively in our colleges and technical schools. Professor Wood has been a very diligent contributor to a large number of mathematical and scientific periodicals, and has thereby done much toward stimulating interest and activity in applied mathematics.

The year 1863 is marked in the history of the University of Michigan by the departure of Brunnow and the arrival of Olney. Prof. Edward Olney occupied the chair of mathematics until his death, in 1887. He was born in Moreau, Saratoga County, N. Y., in 1827. With slender opportunities for early education, he achieved through his own energy distinction as a teacher and scholar. He began his career as a teacher in elementary schools. Though he had himself never studied Latin, he began teaching it and he kept ahead of his class, "because he had more application." He thus educated himself in languages as well as in mathematics. He acquired great teaching power, and it is to this that his great success is chiefly due. During the ten years preceding his appointment at Ann Arbor, he was professor at Kalamazoo College, Michigan.

At the University of Michigan his teaching was marked by great thoroughness. He was a rather slow man, and took great pains with the poorer students. He had the happy faculty of inducing all students to perform faithful work. It is related that the son of a certain prominent Congressman once labored under the conceit that his father's reputation would exempt him from the necessity of studying whenever he felt disinclined to do so. Once, when being called upon to recite, he answered, "not prepared." Professor Olney assured him that the lesson was easy, asked him to rise from his seat, and then proceeded, much to the amusement of the rest of the class, to develop with him the entire lesson of the day by asking him questions. In that way was spent the whole hour. The class was made to assist him in some of the more difficult points. The Congressman's son concluded, on that occasion, that it was, after all, more agreeable to his feelings to prepare his mathematics carefully in his own room than to expose his ignorance before the whole class by being kept reciting for a whole hour. At times Professor Olney enjoyed joking at the expense of those who would not be injured by it. The result of his teaching was a high average standing among students. The first important step toward reaching good results consisted in a strict adherence to the requirements laid down for admission. If a student failed in his entrance examination, then Professor Olney took much pains to see that the deficiencies would be made up under a competent private teacher who was personally known to him. The rigid requirements for admission gave the mathematical department great leverage.

Professor Olney was an active promoter of various humanitarian enterprises, and was much interested in the educational work of the Baptist denomination, of which he was a member. He was interested in the progress of Kalamazoo College (Baptist) quite as much as in that of Michigan University. His library is now the property of that college. At the time of his death he was engaged in the revision of his series of text-books to meet the increased demands of the times.

In 1860, before Olney was connected with the university, the terms for admission were—to the classical course, arithmetic, and algebra through simple equations; to the scientific course, arithmetic, algebra through quadratic equations and radicals, and the first and third books of Davies' Legendre. In 1864 quadratic equations were added to the classical course, and to the scientific course the fourth book of Legendre. In 1867 the requirements for the classical course were raised so as to equal those in the scientific course, but in the following year quadratic equations were temporarily withdrawn. The fifth book of Legendre was added in the scientific course in 1869. In 1870 all of Legendre was required, and five books in the classical course. In the next year arithmetic, Olney's Complete Algebra, and Parts I and II of Olney's Geometry (including plane, solid, and spherical geometry), were the requirements in both courses. No changes have been made since.

The college curriculum in 1854 was, for both courses, algebra, geometry, trigonometry, analytical geometry, and calculus. The next year calculus was withdrawn from the classical course, but was re-instituted in 1864, and in 1868 was made elective. In 1878 all courses except those for the degree of B. L. (English) embraced calculus. In 1881 the B. L. course included trigonometry. Since then calculus has been elective in all courses except the scientific. Analytical geometry has been added to the B. L. course.

During the last eight or ten years the "university system" has been growing rapidly at Ann Arbor. Mathematical studies of university grade have been offered. Determinants, quaternions, and modern analytical geometry were first announced in 1878; higher algebra in 1879; synthetic geometry and elliptic functions in 1885; theory of functions in 1886; differential equations (advanced) in 1887. The calculus of variations (probably as much as is contained in Church's or Courtenay's Calculus) was announced first in 1866.

The text-books which have been used at the University of Michigan, at different periods, are as follows:

*Algebra*.—Davies' Bourdon, Ray's—Part II, Olney's University Algebra, Newcomb's College Algebra, Chas. Smith's Treatise on Algebra, Salmon's Higher Algebra, Barnside and Panton.

*Determinants*.—Muir, Scott, Dostor, Peck.

*Geometry*.—Davies' Legendre, Olney, Ray.

*Trigonometry*.—Davies' Legendre, Loomis, Olney.

*Synthetic Geometry*.—Reye, Steiner.

*Analytic Geometry*.—Davies, Loomis, Church, Olney, Peirce's Curves, Functions, and Forces, Chas. Smith, Salmon, Frost, Aldis, Whitworth, Ciebach.

*Calculus*.—Davies, Church, Loomis, Courtenay, Olney, Price, Todhunter, Williamson, Jordan.

*Differential Equations*.—Boole, Forsyth.

*Calculus of Variations*.—Todhunter, Carll.

*Quaternions*.—Kelland & Tait, Hardy, Tait.

*Elliptic Functions*.—Durège, Bobek, Jordan.

Prof. G. C. Comstock, of the Washburn Observatory, gives the following reminiscences of the mathematical instruction at Ann Arbor:\*

"I entered the University of Michigan in the fall of 1873, with a preparation in mathematics consisting of arithmetic, elementary algebra through quadratic equations and including a very hurried view of logarithms, and plane, solid, and spherical geometry. The mathematical course given in the university at that time comprised, in the Freshman year, Olney's University Algebra, inventive geometry (consisting of an assignment of theorems for which the student was expected to find demonstrations), and plane and spherical trigonometry. In the Sophomore year, general geometry and differential and integral calculus. Descriptive geometry was required of engineering students, and was occasionally taught to others.

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\* Letter to the writer, November 6, 1893.

"The Freshmen were taught by instructors, usually young men of not much experience in teaching, but once a week they (the students) went up to Professor Olney for a review of the week's work, and these occasions were the trials of a Freshman's life. Olney's stern and rigid discipline had won for him among students the sobriquet "Old Toughy." He was not, however, a harsh man, and although the students stood in awe of him I think that he was generally liked by them. One feature of the weekly reviews may serve to illustrate his discipline and his power of enforcing it. He insisted upon the attention of each student being given to the demonstrations and explanations which the person reciting was engaged upon, and given so closely that the latter might be stopped at any point and any other student required to take up the demonstration at that point and carry it on without duplicating anything which had already been given.

"The University Algebra given the Freshman class contained an elementary view of infinitesimals, extending to the differentiation of algebraic functions and the use of Taylor's formula; and also a presentation of loci of equations, by which the student became familiar with the geometrical representation of an equation. The Sophomore thus came to this study of general geometry and calculus with some preliminary notions of these subjects. The study of the calculus was elective, but every Sophomore was required to take an elementary course in general geometry, and to make use here of the principles of the calculus which he had learned as a Freshman.

"Professor Olney's tastes were decidedly geometrical in character, and he constantly sought to translate analytical expressions into their geometrical equivalents, and much of his success as a teacher is probably due to this.

"Professor Beman, on the other hand, is an analyst, a 'lightning mathematician' in the student vernacular, and, in my day, the facility with which he handled mathematical expressions daunted and discouraged the student, who usually felt that he did not get much from Professor Beman.

"The criticism which I should now make upon the mathematical teaching which I received, is that little or no attempt was made to point out the applications of mathematics, and to encourage the student to apply it to those numerous problems of physical science, of engineering, and of navigation, which serve as powerful stimulants to the interest. The student was taught how to solve a spherical triangle, and how to look out logarithms from a table, but was never required to solve such a triangle and obtain numerical results.

"The text-books in use were those written by Professor Olney, none other being employed even for reference. There were no mathematical clubs or seminars, and no facilities offered for the study of mathematics beyond the prescribed curriculum."



Professor Olney is the author of a complete set of mathematical text-books, which have displaced the works of Davies, Loomis, and Robinson in many schools, both in the East and in the West. His works are quite distinctive in the arrangement of subjects, and mark a decided advance over the other books just named. In the explanatory notes added here and there, in the tabular views at the end of chapters, in the judicious selection of examples, we see the fruits of long experience in the class-room. His books exhibit him in the light of a great teacher rather than a great mathematician. He was greatly aided in his work by Professor Beman, who prepared all the "keys" to the mathematical books, and did a great deal of critical work. It has been stated that Professor Olney could never get his publishers to print the books in the form which seemed the most perfect to him. He considered the traditional classification of mathematical subjects very defective, and wished to write a *System of Mathematics* in which he could embody his own ideals on this point. He thought, for example, that a considerable part of algebra should be taught before taking up the advanced parts of arithmetic, such as percentage and its applications, and that plane geometry should precede mensuration in arithmetic. By discarding the usual division of mathematics into separate volumes on arithmetic, algebra, geometry, etc., and by writing a *system of mathematics* he hoped to introduce great improvements. The publishers, on the other hand, preferred the traditional classification, as the books would then meet with larger sale. Professor Olney was thus hampered, to some extent, in the execution of his ideal scheme.

In his published works, the science of geometry is brought under two great heads, *Special or Elementary Geometry*, and *General Geometry*. The former consists of four parts: The *First Part* is an empirical geometry, designed as an introduction, in which the fundamental facts are illustrated but not demonstrated. The *Second Part* contains the elements of demonstrative geometry, designed for schools of lower grade. The *Third Part* was written to meet the special needs at the University of Michigan. It was studied in the Freshman class by students who had mastered the *Second Part*. The effort is made here to encourage original research. This part contains also applications of algebra to geometry, and an introduction to modern geometry. The *Fourth Part* consists of plane and spherical trigonometry, treated geometrically. The old "line-system" is still retained here.

General Geometry was intended to be developed by him in two separate volumes, but only the first was published. The first treats of plane loci, the second was intended for loci in space. This first volume may be very roughly described as covering the field generally occupied by analytical geometry and calculus. Olney favored the infinitesimal method, which he used also in his *Elementary Geometry*, where he permits the number of sides of a regular polygon circumscribed about a circle to become "infinite," and to coincide with the

circle. We are glad that this method is at the present time being more and more eliminated from *elementary* text-books. It is worthy of note that in his calculus Olney gives the elegant method, discovered by Prof. James C. Watson, of demonstrating the rule for differentiating a logarithm without the use of series.

In some courses the subjects have been taught exclusively by lectures, but the present tendency is to use the best text-book available, and supplement it with lectures as may be found advisable. Of late years a good deal of attention has been given to the careful and critical reading of such works as Salmon's *Conic Sections*, Higher Algebra, Geometry of Three Dimensions, Frost's *Solid Geometry*, Jordan's *Cours d'Analyse*, Forsyth's *Differential Equations*, Price's *Calculus*, Carll's *Calculus of Variations*, Burnside and Panton's *Theory of Equations*, Reye's *Geometrie der Lage*, Steiner's *Vorlesungen über synthetische Geometrie*, Clebsch's *Vorlesungen über Geometrie der Ebene*. It is thought that better results have been secured in this way than when the student's attention is largely given to the taking of notes.

Since the death of Professor Olney, Professor Beman has been filling the professorship of mathematics. He graduated at the University of Michigan in 1870. Excepting the first year after graduation (when he was instructor in Greek at another institution), he has been teaching continually at his *alma mater*—from 1871 to 1874 as instructor in mathematics, then as assistant professor and as associate professor of mathematics, and, finally, as full professor. He has done much toward introducing the "university system" in his department, and has been a contributor to our mathematical journals, particularly to the *Analyst* and the *Annals of Mathematics*.

For several years Charles N. Jones has been professor of applied mathematics. He has been a very successful teacher of mechanics. Professor Beman has two or three assistants in the department of pure mathematics.

A mathematical club was organized in 1887. It is under the control of the students, but an active interest is continually shown by the various instructors. Papers of some length are presented, problems discussed, etc.

#### UNIVERSITY OF WISCONSIN.

The University of Wisconsin was organized in 1848, and formally opened in 1850. A preparatory department was established in 1849, and it was not till 1851 that regular college classes were formed. Like most other State universities, the University of Wisconsin had a hard struggle for existence during its early years. Our State Legislatures did not always pursue a wise course toward their higher institutions of learning. The lands which were granted to the States by the General Government for the support of higher education were disposed of in a manner intended to "encourage immigration," rather than to foster a great

university. But in later years, say since 1875, the policy of the Wisconsin Legislature has been much more liberal, and the university has been advancing with prodigious strides.

The first professor connected with the institution was John W. Sterling. He was the teacher in the preparatory department, which was started in 1849, in a small building, before the university had any large buildings of its own. After the college department was organized, Sterling became professor of mathematics and natural philosophy, which position he retained until about 1867, when a separate chair was created for physics. From that time on until June, 1881, he was professor of mathematics.

Professor Sterling was born July 17, 1816, in Wyoming County, Pa., and died in March, 1885, at Madison, Wis. He was graduated at the College of New Jersey in 1840, and at the Princeton Theological Seminary in 1844. His mathematical and astronomical instruction at Princeton must have been received from Prof. A. B. Dod and Prof. Stephen Alexander. He went to Wisconsin in 1846, and became professor in Carroll College, Waukesha. Three years later he entered upon his long career as professor at the University of Wisconsin. For one-third of a century he was connected with that institution. Never did man work more faithfully than did he for its advancement. When the university was passing through the "*Sturm und Drang Periode*," and when it was without a head, he more than once, as dean of the faculty, assumed the duties of president. He was a man of industry and energy, and was ready to teach any branch, on an emergency. Among the students he was popular. He encouraged faint-hearted students, took them to his table, lent or gave them money when he had little himself. He invariably treated students like gentlemen of mature judgment and common sense. The great mass of students appreciated this, but occasionally there were some too young to do so and who should have received severer treatment and more summary action. In his prime Professor Sterling was a man of great physical strength. During even his last years he walked as erect as a young man of twenty.

He took a living interest in mathematics even during the last days of his life. Though he may not have kept pace with recent advances in this science, he had a good knowledge of such subjects as were treated in our ordinary American text-books. He never published any works of his own. When Professor Watson, the astronomer, came from Ann Arbor to the University of Wisconsin, in order to take charge of the magnificent new observatory erected by the munificence of Governor Washburn, an agreement was contemplated or reached between Watson and Sterling to prepare jointly a series of mathematical text-books. Watson's wonderful mathematical talent and Sterling's long experience in teaching would, indeed, have made a strong combination, but the scheme was frustrated by the untimely death, in 1880, of the great astronomer.

In the class-room Sterling's discipline was characterized by great mildness. He would carefully explain to the class the principal parts of each lesson. Even in the last year of his teaching his prelections were always very clear, and any student who felt a desire to understand the subjects which he taught, could certainly do so by following the exposition given in the class. While Professor Sterling always explained well, he was, in his last years at least, not sufficiently exacting; he would not compel a boy to study. The consequence was that some got from him a good knowledge of elementary mathematics, while others took advantage of the professor's leniency. In calculus he taught both the method of limits and the infinitesimal method. The text-book was based on the former, but Professor Sterling rather favored the latter. The principles of the calculus were not always unfolded with desired rigor, and not unfrequently some of the best scholars in the class shook their heads at the unceremonial rejection of quantities, simply because they were very, very small.

Among students Professor Sterling went by the familiar name of "Johnnie." In 1881 he was made professor emeritus of mathematics. Though his active duties in the class-room ceased at that time, he continued to take a living interest in all matters pertaining to the university to the end of his days.

We are not able to give the courses in mathematics during the early days of the university. During the last years of his teaching Professor Sterling used Loomis's works throughout. From a communication received by the writer from Prof. James D. Butler, it would appear that the works of Loomis were the first ones taught in pure mathematics by Professor Sterling. In algebra he used Loomis, afterward Davies, and then again Loomis. In conic sections he used at one time the work of Coffin. "Smith's Analytic Geometry" is also one of the books mentioned. This was most likely F. H. Smith's translation of Biot. Other books mentioned are Peck's *Mechanics*, Robinson's *Astronomy*, Snell's *Olmsted's Astronomy*, Snell's *Olmsted* in optics and pneumatics, and Loomis's *Calculus*.

In 1876-77 the Freshmen studied Loomis's *Algebra*, beginning with quadratics, Loomis's *Geometry*, Loomis's *Plane Trigonometry*. The Sophomores were instructed in Loomis's *Conic Sections* and *Analytic Geometry*, *Practical Surveying* (six weeks), and *Calculus*. This ended the course in pure mathematics. The Juniors were offered Peck's *Mechanics* and "lectures." The mathematical course for engineering students embraced also descriptive geometry (Church). All students were required to pursue mathematics through analytic geometry; the calculus was elective except to students in civil and mechanical engineering. Until about the year 1878, William J. L. Nicodemus was professor of military science and civil and mechanical engineering. He was spoken of by students as a man of great ability in his line. On the death of Nicodemus one of his pupils, Allan Darst Conover, assumed

charge of the department of civil engineering. In mechanical engineering the instruction fell into the hands of Storm Bull, a relative of the celebrated Ole Bull. Prof. Storm Bull studied at the Polytechnicum in Zurich, Switzerland, and is a thorough master of the subjects which he teaches. Descriptive geometry has been taught by him ever since his connection with the university.

On Sterling's retirement the management of the mathematical department was entrusted to Charles A. Van Velzer, a young man who for three years had listened to the inspiring words of Professor Sylvester at the Johns Hopkins University. Van Velzer graduated at Cornell University in 1876. After having been instructor at his *alma mater* for one year, he went to the Johns Hopkins University, where he was honored with a fellowship in mathematics. His power for original research is exhibited in his contributions to the *American Journal of Mathematics* (on "Compound Determinants"), the *Johns Hopkins University Circulars*, the *Analyst*, and the *Mathematical Magazine*.

In the fall of 1888 appeared, in two separate volumes, a preliminary edition of Van Velzer and Slichter's "Course in Algebra." Slichter is assistant professor of mathematics at the university. This book is now used in the Freshman class. The preliminary edition was gotten up for the purpose of being tested in the class-room. After the test, such revisions will be made as experience may seem to require. In the regular edition the two parts will be placed together in one volume. The work is not intended for beginners, but for students entering the Freshman class of our colleges, who already possess a fair knowledge of the elements. It impresses the progressive teacher as being different from most other works, and of great excellence. Many an antiquated and traditional notion has been thrown overboard, and many new features have been introduced. They have not been adopted simply for the sake of producing a book different from others; on the contrary, the authors have profited by what seemed good in other algebras.

The first volume of Van Velzer and Slichter's Algebra embraces, in addition to the usual subjects, the theory of limits and derivatives. In the treatment of series the authors not only state, but emphasize the fact that infinite series must be convergent in order to be used with safety. Some teachers might doubt the expediency of introducing Taylor's Formula into a book on algebra on account of the difficulty encountered in a complete and rigorous proof of it.

The second volume contains chapters on imaginaries, the discussion of the rational integral function of  $x$ , the solution of numerical equations of higher degree, graphic representation of equations, and determinants. These five chapters cover 75 pages. The treatment of these subjects appears to us admirable. Not more is given on each subject than can be conveniently taught in any college whose pupils possess a thorough knowledge of algebra through quadratics before entering the Freshman

class. A pleasant feature of the work is the occasional "historical notes." This is the first American work on algebra, as far as we know, which states explicitly that the logarithms invented by Napier are different from the natural logarithms.

The strongest feature of this algebra is its style. Students who have been in Professor Van Velzer's class-room will perceive that his great power of oral explanation and elucidation has been happily transferred to the printed page. Nowhere is the language of the book above the comprehension of ordinary students. The objective method of explanation is adopted throughout.

To Professor Van Velzer belongs the credit of introducing the modern higher mathematics into the University of Wisconsin. The writer knows of a student of great taste for mathematics, who studied Loomis's Calculus in the year preceding the arrival of Van Velzer, in Madison, and who labored under the impression that he had mastered about all that was to be known in *pure* mathematics. He was no little surprised when the new professor, fresh from the Johns Hopkins University, began to talk about determinants, quaternions, theory of functions, theory of numbers, and multiple algebra. The student's pride was wounded when he learned that Loomis's Calculus could convey only a very meagre knowledge of the transcendental analysis.

In 1883 some alterations were made in the mathematical requirements for admission. During the years immediately preceding, the requirements for all the courses of the university had been, arithmetic, algebra through quadratic equations, and plane geometry. At the time named above, solid geometry was added to the requisitions for all regular courses in the university except the "ancient classical."

The university has established close and friendly relations with the high schools in the State, and the number of "accredited high schools" is now fifty-six. Of these only six, however, prepare students for *all* courses in the university. This intimate relation with the high schools has had a wholesome influence upon both the university and the high schools.

As regards the regular classes of mathematics in the college, we may say that since the retirement of Professor Sterling, Loomis's Algebra has been retained until 1888. Now, Van Velzer and Slichter's Algebra is used. In trigonometry, Wheeler's work was introduced in 1882. Before that time Loomis's was taught. In solid geometry, Wentworth's has been used lately, in place of Loomis's. In analytical geometry, Loomis's work was superseded some years ago by the English work of Smith. In calculus, Professor Van Velzer has taught Byerly's, but this year (1888-89) he is using Newcomb's.

In the Sophomore year, and more especially in the Junior and Senior years, the elective system has been in operation, with some restrictions. Since 1881 elective studies in pure mathematics, covering the calculus and other branches, have been offered every year. There have always

been students with a taste for the higher branches of mathematics. In later years the attendance upon these branches has been on the increase. In the winter term of 1881-82 determinants were taught for the first time at the University of Wisconsin. In the spring term was organized a class of five or six students in quaternions. Hardy's text-book was used. Lately Professor Van Velzer has preferred the work by Kelland and Tait. During the year 1882-83 there was an elective class of about the same number as the preceding, studying Boole's Differential Equations. Professor Van Velzer's constant aim was to induce students to do independent work. He was always glad to listen to such modified treatment of the lesson in the book as the student might think of. This method of conducting the recitation gave rise to many interesting and profitable discussions. Considerable time was given to the subject of singular solutions. The work of Boole was still used in 1887-88, but from now on, that of Forsyth will be used, the former being out of print.

The special courses in pure mathematics during the last two years have been as follows: Class of two students in Boole's Differential Equations in the fall term of 1886-87, three hours per week; class of two in the same text-book, winter term of 1886-87, two hours per week; class of six in modern algebra (no text-book), winter term of 1886-87, three hours per week; class of six in Boole's Differential Equations, winter term of 1887-88, three hours per week; class of three in Boole's Differential Equations, spring term of 1887-88, three hours per week; class of six in Kelland and Tait's Quaternions, spring term of 1887-88, three hours per week; class of seven in Smith's Analytical Geometry of Three Dimensions, fall term of 1887-88, three hours per week; class of three in quantics (Salmon), fall term of 1887-88, two hours per week.

It is the practice at the University of Wisconsin to give special honors, upon the recommendation of the professors in the several departments, to the candidates for the bachelor's degree who have done special work under the direction of the professor of any department and prepared an acceptable thesis; but the amount of work required for a special honor must be at least the equivalent of a full study for one term, and in case of those branches in which there are longer or shorter elective courses, the student must have taken the longer course. It has been specified, furthermore, that candidates for special honors must have a general average standing of 85, and one of 93 per cent. in the department of which the application is made.

The number of special honor students in mathematics in late years has been quite as great, if not greater, than in any other department, though the studies of this department are, to say the least, as difficult as those of any other. In the class of '81 there were three special-honor men in mathematics. The titles of their theses were as follows: "Singular Solutions of Differential Equations," "Pole and Polar and Reciprocal

**Polars in Curves and Surfaces of the Second Order,"** and **"Development and Dissection of Riemann's Surfaces."** Should it be claimed that these theses are the work of immature students, then we may answer that for candidates for the bachelor's degree they are nevertheless creditable. The writer of the first thesis (L. M. Hoskins) is now doing excellent work as instructor in engineering at the university. The writer of the second thesis (L. S. Hulburt) is now professor of mathematics at the university of Dakota. M. Updegraff, of the class of '84, wrote a thesis on **"Resultants."** He holds now a responsible position at the National Observatory at Cordoba, Argentine Republic, South America. Titles of later "special-honor theses" are, **"Approximation to the Roots of Numerical Equations,"** **"Maxima and Minima,"** **"On the Equation  $\sin my \cos ny = \sin mx \cos nx$ ,"** **"Different Systems of Co-ordinates."** These theses are certainly indicative of a healthful activity in the under-graduate mathematical department.

For special studies pursued after graduation and the presentation of an acceptable thesis, the degree of Master is conferred. The following are the titles of two theses written to secure the degree of "master of science in mathematics:" **"The Hodograph,"** **"On a Quadratic Form"** (in the theory of numbers).

The present courses in mathematics offered at the University of Wisconsin (catalogue 1887-88) are as follows:

**Subcourse I, Algebra.** Five exercises a week during the fall term. (Professor Van Velzer and Mr. Slichter.)

*Required of Freshmen in all courses.*

**Subcourse II, Theory of Equations,** including the elements of determinants, and graphic algebra. Five exercises a week during the winter term. (Professor Van Velzer and Mr. Slichter.)

*Required of Freshmen in the Modern Classical, English, General Science, and Engineering Courses.*

**Subcourse III, Solid Geometry.** Five exercises a week during the winter term. (Professor Van Velzer or Mr. Slichter.)

*Required of Freshmen in the Ancient Classical Course.*

**Subcourse IV, Trigonometry.** Five exercises a week during the spring term. (Professor Van Velzer and Mr. Slichter.)

*Required of Freshmen in all courses.*

**Subcourse V, Descriptive Geometry.** The topics taught embrace the projection of lines, planes, surfaces, and solids, the intersection of each of these with any one of the others, tangent lines to curves and surfaces and tangent planes to surfaces, problems in shades and shadows, of lines and surfaces, linear perspective and isometric projection. The class-room exercises are accompanied by work in the draughting room. The text-book used is Church's Descriptive Geometry. Full study during the spring term, Freshman year, and three-fifths study during the fall term, Sophomore year. (Professor Bull.)

*Required of Freshmen in Civil and Mechanical Engineering. Elective for other students.*

**Subcourse VI, Analytic Geometry.** Five exercises a week during the fall term. (Professor Van Velzer.)

*Required of engineering Sophomores and scientific Sophomores who pursue mathematical, physical, or astronomical studies. Elective for other students.*



Subcourse VII, *Differential Calculus*. Five exercises a week during the winter term. (Professor Van Velzer.)

*Required of engineering Sophomores and scientific Sophomores who pursue mathematical, physical, or astronomical studies. Elective for other students.*

Subcourse VIII, *Integral Calculus*. Five exercises a week during the spring term. (Professor Van Velzer.)

*Required of engineering Sophomores and scientific Sophomores who pursue mathematical, physical, or astronomical studies. Elective for other students.*

Subcourse XIX, *Method of Least Squares*. This is a course in the theory of probabilities as applied to the adjustment of errors of observation. It will be first given in 1890. Must be preceded by subcourses VI, VII, and VIII, three-fifths study during the winter term. (Mr. Hoskins.)

*Required of Seniors in Civil Engineering.*

Subcourses IX to XVIII, *special advanced electives*. Courses varying from year to year are offered in the following subjects: IX, *Modern Analytic Geometry*; X, *Higher Plane Curves*; XI, *Geometry of Three Dimensions*; XII, *Differential Equations*; XIII, *Spherical Harmonics*; XIV, *Elliptic Functions*; XV, *Theory of Functions*; XVI, *Theory of Numbers*; XVII, *Quantics*; and XVIII, *Quaternions*.

Very good work has been done, at times, by students in the department of mathematical physics. Prof. John E. Davies, the professor of physics, takes a living interest in pure as well as applied mathematics. His reading in pure mathematics has, indeed, been very extensive. Mathematical reading is a recreation to him. He would not unfrequently take with him some mathematical work—as, for instance, Tait's *Quaternions*—to faculty meetings, that he might pass pleasantly the otherwise tedious sessions of that august assembly. Many years ago he made, for his own use, a complete translation of Koenigsberger's work on *Elliptic Functions*.

The university offers excellent facilities for the study of astronomy. The Washburn Observatory has a large equatorial for use in original work, and also a smaller one for the use of students. After the death of Professor Watson, Professor Holden became director of the Observatory. He held this position until his appointment as director of the Lick Observatory. Prof. George C. Comstock is now professor of astronomy and associate director of the Washburn Observatory. Professor Comstock is a pupil of Watson, and came to Wisconsin from Ann Arbor with Watson. Before assuming the duties of his present position he was for two or three years professor of mathematics and astronomy at the University of Ohio.

The instruction in analytical mechanics is in charge of Mr. L. M. Hoskins, a young man of very marked mathematical talent. He graduated in 1881 at the head of a class of sixty-five, and was afterward appointed fellow in mathematics in Harvard University. Through his influence the study of analytical mechanics had been made much more popular in the engineering courses than it had been formerly. Text-books were selected for instruction of only one. Bowser's *Elements of Analytical Mechanics* is the text-book used.

Mr. Hoskins has contributed to the *Annals of Mathematics*, the *Mathematical Magazine*, and Van Nostrand's *Engineering Magazine*.

## JOHNS HOPKINS UNIVERSITY.

President Daniel C. Gilman once said to the trustees of the Johns Hopkins University, when the question of "How to begin a university" was upon their minds, "Enlist a great mathematician and a distinguished Grecian; your problem will be solved. Such men can teach in a dwelling-house as well as in a palace. Part of the apparatus they will bring, part we will furnish. Other teachers will follow them."\* So it came to pass that, before there were any buildings for classes, a professor of mathematics and a professor of Greek were secured for the new university.

When President Gilman was engaged in the all-important work of selecting men for the above positions, he may have been actuated in his choice by thoughts similar to those of Prof. G. Chrystal, who, before a learned body of English scientists, once expressed himself as follows:† "Science can not live among the people, and scientific education can not be more than a wordy rehearsal of dead text-books, unless we have living contact with the working minds of living men. It takes the hand of God to make a great mind, but contact with a great mind will make a little mind greater. The most valuable instruction in any art or science is to sit at the feet of a master, and the next best, to have contact of another who has himself been so instructed."

Is there a student among us who has studied with Sylvester and who will deny the truth of the above? Is there a mathematician, who has sat as a pupil at the feet of Benjamin Peirce, who will deny it? It is a fortunate circumstance for the progress of the exact sciences in this country that, at a time when the "Father of American Mathematics" was approaching his grave, there came among us another master who gave the study of mathematics a fresh and powerful impulse. Professor Sylvester is a mathematical genius, who has no superior in England, except, perhaps, Professor Cayley.

James Joseph Sylvester was born in London in 1814, and was educated at the University of Cambridge. He came to this country to fill the professorship at the University of Virginia when he was a very young man, but his stay among us then was very short. He became a member of the Royal Society at the age of twenty-five. For some time he was professor of natural philosophy in University College, London. In 1855 he became professor of mathematics in the Royal Military Academy at Woolwich, and in 1876 was elected for the position at the Johns Hopkins University.

Sylvester's activity has been wonderful. Prior to 1863 he published 112 scientific memoirs, which are recorded in the Royal Society's Index of Scientific Papers. A most important paper, printed in the Philo-

\* Annual report of the president of the Johns Hopkins University, 1888, p. 29.

† *Nature*, September 10, 1885, Section A of Brit. Association, opening address by Prof. G. Chrystal, president of the section.

sophical Transactions of 1864, is Sylvester's Theorem on Newton's Rule for discovering the number of real and imaginary roots of an equation. Of this Todhunter says: "If we consider the intrinsic beauty of the theorem, . . . the interest which belongs to the rule associated with the great name of Newton, and the long lapse of years during which the reason and extent of that rule remained undiscovered by mathematicians, among whom Maclaurin, Waring, and Euler are explicitly included, we must regard Professor Sylvester's investigations made to the theory of equations in modern times justly to be ranked with those of Fourier, Sturm, and Cauchy." A few of his numerous other investigations, made before coming to Baltimore, are on the Rotation of a Rigid Body; on the Analytical Development of Fresnel's Optical Theory of Crystals; on Reversion of Series; on the Involution of Six Lines in Space, "culminating in the result that if these six lines represent forces in equilibrium they must lie on a ruled cubic surface;" on a general theorem by which, for instance, the quintic can be expressed as the sum of three fifth powers. In 1859 he gave a course of lectures at King's College, London, on the subject of The Partitions of Numbers and the Solution of Simultaneous Equations in Integers, in which it fell to his lot "to show how the difficulties might be overcome which had previously baffled the efforts of mathematicians, and especially of one bearing no less venerable a name than that of Leonard Euler," and also laid the basis of a method which has since been carried out to a much greater extent in his "Constructive Theory of Partitions," published in the American Journal of Mathematics, in writing which he "received much valuable co-operation and material contributions" from his "pupils in the Johns Hopkins University."†

Professor Sylvester's most celebrated work has been in modern higher algebra. A very large portion of the theory of determinants is due to him, and the epoch-making theory of invariants owes its origin and early development almost exclusively to his genius and that of Professor Cayley.

The Johns Hopkins University offered to Professor Sylvester every facility for original work that could be desired. By the system of "fellowships" a number of talented young men were drawn to Baltimore, who were capable not only of understanding the teachings of their great master, but in many cases, also of aiding him in his researches. The university, moreover, started the American Journal of Mathematics, in which all investigations in mathematics could be published and thereby brought before the mathematical public. Professor Sylvester's time was not taken up by the usual routine work in school, but was almost wholly given to the pursuit of his favorite subjects. He lectured, perhaps, two or three times per week, but these lectures generally discussed some new discovery in algebra.

\* *Proc. of the Acad. Nat. Sci. Phila.*

† *Lecture on the Theory of Partitions*, by Professor Sylvester before the University of Oxford, December 12, 1859, published in *Nature*, January 7, 1860.

Though he had passed his sixtieth year before he came to the Johns Hopkins University, his mind seemed to be as strong and active as ever. The group of students he had gathered about him were almost constantly made to feel the glow of new ideas or of old ones in a new form. From 1877 to 1882, Professor Sylvester contributed thirty articles and notes to the *American Journal of Mathematics*; twenty-two to the *Comptes Rendus de l'Académie des Sciences de l'Institut de France*; one paper to the Proceedings of the Royal Society, "On the Limits to the Order and Degree of the Fundamental Invariants of Binary Quantities" (1878); four to the *Messenger of Mathematics*; four to the London, Edinburgh, and Dublin Philosophical Magazine; six to the *Journal für reine und angewandte Mathematik*, Berlin.\* If this list be complete, the number of original papers published by him while at the Johns Hopkins University was sixty-seven. Special mention may be made here of a proof by Professor Sylvester, printed in the Philosophical Magazine for 1878, of a theorem on the number of linearly independent differentiants, which had been awaiting proof for over a quarter of a century. He was led to undertake the investigation of this subject by a question put to him by one of his students in connection with a footnote given at one place in Faà de Bruno's *Théorie des Formes Binaires*.

Since his return to England, Sylvester has been developing a new subject, which he calls the "Method of Reciprocants." The lectures which he delivered on this subject at the University of Oxford have been reported by Mr. Hammond and published in the *American Journal of Mathematics*.

Sylvester has manufactured a large number of technical terms in mathematics. He himself speaks on this point as follows: "Perhaps I may, without immodesty, lay claim to the appellation of the mathematical Adam, as I believe that I have given more names (passed into general circulation) to the creatures of the mathematical reason than all the other mathematicians of the age combined."†

In his writings, Professor Sylvester is often very eloquent. His style is peculiarly flowery, and indicative of very powerful imagination. His articles are frequently interspersed with short pieces of poetry, either quoted or of his own composition. Thus, in his article in *Nature*, January, 1886, is given a short poem, "On a Missing Member of a Family Group of Terms in an Algebraical Formula;" followed by this sentence: "Having now refreshed ourselves and bathed the tips of our fingers in the Pierian spring, let us turn back for a few brief moments to a light banquet of the reason."

Since the beginning of the Johns Hopkins University, twenty fellowships have been open annually to competition, each yielding five hundred dollars and exempting the holder from all charges for tuition. This system was instituted for the purpose of affording to young men

\* U. S. Bureau of Education, Circular of Information No. 1, 1893, p. 220.

† *Nature*, Dec. 15, 1887, p. 152, note.

of talent an opportunity of continuing their studies in the university, while looking forward to positions as professors, teachers, and investigators. They have been given to graduate students who showed particular aptitude for advanced work in their chosen specialty. During the time when Sylvester was connected with the university there were nearly always three or four fellowships granted to mathematical students, but, in recent years the number has been reduced to two, in consequence of an increase in the number of departments in the university, among which the fellowships must be divided. Among the first holders of fellowships in mathematics were Thomas Craig (1876-78), George B. Halsted (1876-78), Fabian Franklin (1877-79), W. I. Struham (1878-80), C. A. Van Velzer (1878-81), all holding leading and responsible positions now, as professors of mathematics.

Professor Sylvester's first high class at the new university consisted of only one student, G. B. Halsted, who had persisted in urging Sylvester to lecture on the modern algebra. The attempt to lecture on this subject led him into new investigations in quantics. In his address on Commemoration Day at the Johns Hopkins, he spoke about this work as follows:

"This is the kind of investigation in which I have for the last month or two been immersed, and which I entertain great hopes of bringing to a successful issue. Why do I mention it here? It is to illustrate my opinion as to the invaluable aid of teaching to the teacher, in throwing him back upon his own thoughts and leading him to evolve new results from ideas that would have otherwise remained passive or dormant in his mind.

"But for the persistence of a student of this university in urging upon me his desire to study with me the modern algebra I should never have been led into this investigation; and the new facts and principles which I have discovered in regard to it (important facts, I believe), would, so far as I am concerned, have remained still hidden in the womb of time. In vain I represented to this inquisitive student that he would do better to take up some other subject lying less off the beaten track of study, such as the higher parts of the calculus or elliptic functions, or the theory of substitutions, or I wot not what besides. He stuck with perfect respectfulness, but with invincible pertinacity, to his point. He would have the new algebra (Heaven knows where he had heard about it, for it is almost unknown in this continent), that or nothing. I was obliged to yield, and what was the consequence? In trying to throw light upon an obscure explanation in our text-book, my brain took fire, I plunged with re-quickened zeal into a subject which I had for years abandoned, and found food for thoughts which have engaged my attention for a considerable time past, and will probably occupy all my powers of contemplation advantageously for several months to come."

This extract describes the beginning of his scientific activity and productiveness in the New World.

It may not be without interest to learn what some of his former pupils at the Johns Hopkins University have to say about him. Says Dr. G. B. Halsted:

"Young Americans could hardly realize that the great Sylvester, who with Cayley outranks all English-speaking mathematicians, was actually at work in our land. All young men who felt within themselves the divine longing of creative power hastened to Baltimore, made at once by this Euclid a new Alexandria. It was this great awakening and concentration of mathematical promise, and the subsequent facilities offered for publication of original work, which, rather than any teaching, made the American renaissance in mathematics. \* \* \*

"A short, broad man of tremendous vitality, the physical type of Hereward, the Last of the English, and his brother-in-arms, Winter, Sylvester's capacious head was ever lost in the highest cloud-lands of pure mathematics. Often in the dead of night he would get his favorite pupil, that he might communicate the very last product of his creative thought. Everything he saw suggested to him something new in the higher algebra. This transmutation of everything into new mathematics was a revelation to those who knew him intimately. They began to do it themselves. His ease and fertility of invention proved a constant encouragement, while his contempt for provincial stupidities, such as the American hieroglyphics for  $\pi$  and  $e$ , which have even found their way into Webster's Dictionary, made each young worker apply to himself the strictest tests.

"To know him was to know one of the historic figures of all time, one of the immortals; and when he was really moved to speak, his eloquence equalled his genius. I never saw a more astonished man than James Russell Lowell listening to the impassioned oratory of Sylvester's address upon the bigotry of Christians.

"That the presence of such a man in America was epoch-making is not to be wondered at. His loss to us was a national misfortune."<sup>a</sup>

In answer to an inquiry about Sylvester's methods of teaching, Dr. E. W. Davis (fellow from 1882 to 1884) writes hurriedly as follows: "Sylvester's *methods*! He had none. 'Three lectures will be delivered on a New Universal Algebra,' he would say; then, 'The course must be extended to twelve.' It did last all the rest of that year. The following year the course was to be *Substitutions-Théorie*, by Netto. We all got the text. He lectured about three times, following the text closely and stopping sharp at the end of the hour. Then he began to think about matrices again. 'I must give one lecture a week on those,' he said. He could not confine himself to the hour, nor to the one lecture a week. Two weeks were passed, and Netto was forgotten entirely and never mentioned again. Statements like the following were not unfrequent in his lectures: 'I haven't proved this, but I am as sure as I can

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<sup>a</sup> Letter to the writer, December 25, 1888.

be of anything that it must be so. From this it will follow, etc.' At the next lecture it turned out that what he was so sure of was false. Never mind, he kept on forever guessing and trying, and presently a wonderful discovery followed, then another and another. Afterward he would go back and work it all over again, and surprise us with all sorts of side lights. He then made another leap in the dark, more treasures were discovered, and so on forever."

Let us now listen to another of his old pupils, Mr. A. S. Hathaway (fellow from 1882 to 1884):

"I can see him now, with his white beard and few locks of gray hair, his forehead wrinkled o'er with thoughts, writing rapidly his figures and formulæ on the board, sometimes explaining as he wrote, while we, his listeners, caught the reflected sounds from the board. But stop, something is not right, he pauses, his hand goes to his forehead to help his thought, he goes over the work again, emphasizes the leading points, and finally discovers his difficulty. Perhaps it is some error in his figures, perhaps an oversight in the reasoning. Sometimes, however, the difficulty is not elucidated, and then there is not much to the rest of the lecture. But at the next lecture we would hear of some new discovery that was the outcome of that difficulty, and of some article for the Journal, which he had begun. If a text-book had been taken up at the beginning, with the intention of following it, that text-book was most likely doomed to oblivion for the rest of the term, or until the class had been made listeners to every new thought and principle that had sprung from the laboratory of his mind, in consequence of that first difficulty. Other difficulties would soon appear, so that no text-book could last more than half of the term. In this way his class listened to almost all of the work that subsequently appeared in the Journal. It seemed to be the quality of his mind that he must adhere to one subject. He would think about it, talk about it to his class, and finally write about it for the Journal. The merest accident might start him, but once started, every moment, every thought was given to it, and, as much as possible, he read what others had done in the same direction; but this last seemed to be his weak point; he could not read without meeting difficulties in the way of understanding the author. Thus, often his own work reproduced what others had done, and he did not find it out until too late.

"A notable example of this is his theory of cyclotomic functions, which he had reproduced in several foreign journals, only to find that he had been greatly anticipated by foreign authors. It was manifest, one of the critics said, that the learned professor had not read Kummer's elementary results in the theory of ideal primes. Yet Professor Smith's report on the theory of numbers, which contained a full synopsis of Kummer's theory, was Professor Sylvester's constant companion.

"This weakness of Professor Sylvester, in not being able to read what others had done, is perhaps a concomitant of his peculiar genius. Other minds could pass over little difficulties and not be troubled by them,

and so go on to a final understanding of the results of the author. But not so with him. A difficulty, however small, worried him, and he was sure to have difficulties until the subject had been worked over in his own way, to correspond with his own mode of thought. To read the work of others, meant therefore to him an almost independent development of it. Like the man whose pleasure in life is to pioneer the way for society into the forests, his rugged mind could derive satisfaction only in hewing out its own paths; and only when his efforts brought him into the uncleared fields of mathematics did he find his place in the Universe."

These reminiscences are extremely interesting, inasmuch as they show the workings of a great mind. The mathematical reader will surely enjoy the following reminiscences of "Silly," by one of his favorite pupils, Dr. W. P. Durfee, professor of mathematics at Hobart College, Geneva, N. Y. He was a fellow in mathematics from 1881 to 1883. Speaking of his recollections of Sylvester, he says:

"I don't know that I can do better than preface them by an account, as far as my memory serves me, of the work we did while I was at the Johns Hopkins University. I say *we*, as I always think of the whole staff as working together, so thoroughly did Sylvester inspire us all with the subject which was immediately interesting him. I went to Baltimore in October, 1881, as a fellow, and, though my previous mathematical training had been of the scantiest, I had the courage of ignorance and immediately began to attend Sylvester's lectures, while Mr. Davis and some others thought they would wait for a year and prepare themselves to profit by them. Sylvester began to lecture on the Theory of Numbers, and promised to follow Lejeune Dirichlet's book; he did so for, perhaps, six or eight lectures, when some discussion which came up led him off, and he interpolated lectures on the subject of frequency, and after some weeks interpolated something else in the midst of these. After some further interpolations he was led to the consideration of his Universal Algebra, and never finished any of the previous subjects. This finished the first year, and, although we had not received a systematic course of lectures on any subject, we had been led to take a living interest in several subjects, and, to my mind, were greatly gainers thereby. The second year, 1882-83, he started off on the subject of substitutions, but our experience was similar to that of the preceding year, and I can not now, after the six years which have intervened, disentangle the various topics that engaged his attention. Amongst others were Turley's series, partitions, and universal algebra. He could not lecture on a subject which was not at the same time engaging his attention. His lectures were generally the result of his thought for the preceding day or two, and often were suggested by ideas that came to him while talking. The one great advantage that this method had for his students was that everything was fresh, and we saw, as it were, the very genesis of his ideas. One could not help being inspired by such



teaching, and many of us were led to investigate on lines which he touched upon. He was always pleased at what one had to suggest, and generally bore interruptions with patience. He would often stop to discuss points that arose, and accepted our opinions as of some worth. I must qualify these latter statements somewhat, as he was apt to be partial, and it made all the difference in the world who it was that interrupted him.

"His manner of lecturing was highly rhetorical and elocutionary. When about to enunciate an important or remarkable statement he would draw himself up till he stood on the very tips of his toes, and in deep tones thunder out his sentences. He preached at us at such times, and not infrequently he wound up by quoting a few lines of poetry to impress on us the importance of what he had been declaring. I remember distinctly an incident that occurred when he was at work on his *Universal Algebra*. He had jumped to a conclusion which he was unable to prove by logical deduction. He stated this fact to us in the lecture, and then went on, "GENTLEMEN" [here he raised himself on his toes], "I am *certain* that my conclusion is correct. I will WAGER a hundred pounds to *one*; yes, I will WAGER my *life* on it." The capitals indicate when he rose on his toes and the italics when he rocked back on to his heels. In such bursts as these he always held his hands tightly clenched and close to his side, while his elbows stuck out in the plane of his body, so that his bended arm made an angle of about  $140^\circ$ .

"Personally I had considerable contact with him, as I did work under his direction that made it necessary for me to see him at his rooms. On such occasions I always made an engagement with him two or three days beforehand, and then at his request dropped him a postal, which reached him an hour or two before I went and reminded him that I was coming. I always found him interested in my work and full of suggestions.

"He had one very remarkable peculiarity. He seldom remembered theorems, propositions, etc., but had always to deduce them when he wished to use them. In this he was the very antithesis of Cayley, who was thoroughly conversant with everything that had been done in every branch of mathematics.

"I remember once submitting to Sylvester some investigations that I had been engaged on, and he immediately denied my first statement, saying that such a proposition had never been heard of, let alone proved. To his astonishment, I showed him a paper of his own in which he had proved the proposition; in fact, I believe the object of his paper had been the very proof which was so strange to him."

By request of Professor Sylvester, Professor Cayley, the Sadlerian professor of pure mathematics in Cambridge, England, was associated in the mathematical work of the Johns Hopkins University from January to June, 1882. Of him Dr. Durfee says: "His subject was Abel-

ian and Theta Functions, and he stuck closely to his text. While his work was of great interest and importance, he did not arouse enthusiasm and diffuse inspiration, as Sylvester did."

These were proud days for the Johns Hopkins University, when the two greatest living English mathematicians were lecturing within her walls.

The first associate appointed in mathematics, when the university first opened in 1876, was Dr. W. E. Story. He graduated at Harvard University in 1871, then studied for some years in Germany, receiving the degree of doctor of philosophy at the University of Leipsic in 1875. For one year preceding the opening of the Johns Hopkins University he was tutor of mathematics at Harvard. At the Johns Hopkins University his lectures and his original researches have been chiefly in geometry. He was for several years associate editor of the *American Journal of Mathematics*.

Dr. Story is not only an eminent mathematician, but also a good teacher. He is ever ready to give private interviews to students and to explain to them difficult points, or offer criticisms and suggestions upon original inquiries which the student may be engaged in. Dr. Story is an admirable lecturer, clear, logical, deliberate, proceeding step by step, so that the student may be sure to follow his reasoning. His work on the blackboard is written in an elegant hand, and is always scrupulously accurate. In 1884 the university secured a magnificent set of geometrical models for the study of surfaces. Some of these are often brought by Dr. Story into the lecture-room to illustrate his subject. In his lectures Dr. Story generally follows some particular text-book, such as Clebsch on Conic Sections, Salmon on Analytic Geometry of Three Dimensions, or Steiner on Synthetic Geometry, but he often brings in researches of more recent date, and also inquiries of his own.

Another member of the mathematical staff is Dr. Thomas Craig. He graduated with the degree of civil engineer at Lafayette College in 1875, was one of the first persons elected to a fellowship at the Johns Hopkins University, and in 1878 received the degree of doctor of philosophy. He began lecturing at the university when he was a student. After graduation he was connected for a short period with the U. S. Coast and Geodetic Survey, for which he prepared in 1879 a *Treatise on the Mathematical Theory of Projections*. During his stay in Washington he studied also Theory of Functions from the work of Königsberger, under the direction of Professor Newcomb, of the *Nautical Almanac*. Dr. Craig has made the theory of functions and differential equations his specialty. He has not only kept pace with the most recent rapid advances of these broad and deep subjects, but has added numerous contributions of his own. Most of them have appeared in the *American Journal of Mathematics*, while some have been published in foreign journals. He is working on subjects which are receiving extensive development in the hands of Fuchs, Hermite, Poincaré, Appel,

Darboux, Picard, and others. There seem to be altogether too few Americans interested in this line of work and prepared to participate in its advancement. The mind of Dr. Craig moves with great rapidity. A quick and brilliant student finds his lectures profitable and inspiring. Some of his courses on differential equations and the theory of functions are very advanced and difficult, and can be followed only by the maturest of students.

Dr. Craig associates with the students familiarly. It has been his practice to invite occasionally students to his house to spend a mathematical evening, when all sorts of subjects would be discussed in a free and easy style.

A somewhat more recent appointment as associate in mathematics is that of Dr. Fabian Franklin. He graduated at the Columbian University in 1869, was fellow in mathematics from 1877 to 1879, and received the degree of doctor of philosophy in 1880. He was appointed assistant in mathematics before taking his degree. Franklin always took great interest in Professor Sylvester's researches while the latter was at the Johns Hopkins University, and generally was at work on similar lines, while Dr. Story and Dr. Craig followed more generally lines of investigation of their own. Some of the articles printed in the *American Journal of Mathematics* have appeared under the joint authorship of Sylvester and Franklin. Professor Sylvester entertained the highest opinion of Dr. Franklin.

Dr. Franklin has done more teaching in the under-graduate department than the other members of the mathematical staff, for the reason that he excels them all in his power of imparting instruction. His teaching power is indeed great. It is seldom that a person of so high mathematical talent is as good an instructor of younger pupils. Dr. Franklin possesses a remarkably quick eye for short methods. The student seldom listens to one of his lectures in which proofs are not given in a shorter, simpler manner than in the book; seldom is a paper read in the Mathematical Society which is not followed, in the ensuing discussion, by suggestions by Dr. Franklin of a shorter method. His papers published in the *American Journal of Mathematics* display the same power. As a teacher Dr. Franklin is extremely popular among the students.

In Dr. Story, Dr. Craig, and Dr. Franklin, Professor Sylvester had an extremely efficient corps of fellow-laborers. Their mathematical researches have made their names favorably known wherever advanced mathematics finds a votary.

The instruction for graduates during the time that Professor Sylvester was connected with the university was as follows:\*

*Course of instruction in Algebra, Book, and Attendance, 1876-83.*

In 1876-77 and 1877-78, Professor Sylvester, 1876-77, 2d half-year, 8 hrs.  
1877-78, 1st half-year, 1877-78, 2d half-year, 1878-79, 1st half-year, 1878-79, 2d half-year, 1879-80, 1st half-year, 1879-80, 2d half-year, 1880-81, 1st half-year, 1880-81, 2d half-year, 1881-82, 1st half-year, 1881-82, 2d half-year, 1882-83, 1st half-year, 1882-83, 2d half-year, 1883-84, 1st half-year, 1883-84, 2d half-year, 1884-85, 1st half-year, 1884-85, 2d half-year, 1885-86, 1st half-year, 1885-86, 2d half-year, 1886-87, 1st half-year, 1886-87, 2d half-year, 1887-88, 1st half-year, 1887-88, 2d half-year, 1888-89, 1st half-year, 1888-89, 2d half-year, 1889-90, 1st half-year, 1889-90, 2d half-year, 1890-91, 1st half-year, 1890-91, 2d half-year, 1891-92, 1st half-year, 1891-92, 2d half-year, 1892-93, 1st half-year, 1892-93, 2d half-year, 1893-94, 1st half-year, 1893-94, 2d half-year, 1894-95, 1st half-year, 1894-95, 2d half-year, 1895-96, 1st half-year, 1895-96, 2d half-year, 1896-97, 1st half-year, 1896-97, 2d half-year, 1897-98, 1st half-year, 1897-98, 2d half-year, 1898-99, 1st half-year, 1898-99, 2d half-year, 1899-00, 1st half-year, 1899-00, 2d half-year, 1900-01, 1st half-year, 1900-01, 2d half-year, 1901-02, 1st half-year, 1901-02, 2d half-year, 1902-03, 1st half-year, 1902-03, 2d half-year, 1903-04, 1st half-year, 1903-04, 2d half-year, 1904-05, 1st half-year, 1904-05, 2d half-year, 1905-06, 1st half-year, 1905-06, 2d half-year, 1906-07, 1st half-year, 1906-07, 2d half-year, 1907-08, 1st half-year, 1907-08, 2d half-year, 1908-09, 1st half-year, 1908-09, 2d half-year, 1909-10, 1st half-year, 1909-10, 2d half-year, 1910-11, 1st half-year, 1910-11, 2d half-year, 1911-12, 1st half-year, 1911-12, 2d half-year, 1912-13, 1st half-year, 1912-13, 2d half-year, 1913-14, 1st half-year, 1913-14, 2d half-year, 1914-15, 1st half-year, 1914-15, 2d half-year, 1915-16, 1st half-year, 1915-16, 2d half-year, 1916-17, 1st half-year, 1916-17, 2d half-year, 1917-18, 1st half-year, 1917-18, 2d half-year, 1918-19, 1st half-year, 1918-19, 2d half-year, 1919-20, 1st half-year, 1919-20, 2d half-year, 1920-21, 1st half-year, 1920-21, 2d half-year, 1921-22, 1st half-year, 1921-22, 2d half-year, 1922-23, 1st half-year, 1922-23, 2d half-year, 1923-24, 1st half-year, 1923-24, 2d half-year, 1924-25, 1st half-year, 1924-25, 2d half-year, 1925-26, 1st half-year, 1925-26, 2d half-year, 1926-27, 1st half-year, 1926-27, 2d half-year, 1927-28, 1st half-year, 1927-28, 2d half-year, 1928-29, 1st half-year, 1928-29, 2d half-year, 1929-30, 1st half-year, 1929-30, 2d half-year, 1930-31, 1st half-year, 1930-31, 2d half-year, 1931-32, 1st half-year, 1931-32, 2d half-year, 1932-33, 1st half-year, 1932-33, 2d half-year, 1933-34, 1st half-year, 1933-34, 2d half-year, 1934-35, 1st half-year, 1934-35, 2d half-year, 1935-36, 1st half-year, 1935-36, 2d half-year, 1936-37, 1st half-year, 1936-37, 2d half-year, 1937-38, 1st half-year, 1937-38, 2d half-year, 1938-39, 1st half-year, 1938-39, 2d half-year, 1939-40, 1st half-year, 1939-40, 2d half-year, 1940-41, 1st half-year, 1940-41, 2d half-year, 1941-42, 1st half-year, 1941-42, 2d half-year, 1942-43, 1st half-year, 1942-43, 2d half-year, 1943-44, 1st half-year, 1943-44, 2d half-year, 1944-45, 1st half-year, 1944-45, 2d half-year, 1945-46, 1st half-year, 1945-46, 2d half-year, 1946-47, 1st half-year, 1946-47, 2d half-year, 1947-48, 1st half-year, 1947-48, 2d half-year, 1948-49, 1st half-year, 1948-49, 2d half-year, 1949-50, 1st half-year, 1949-50, 2d half-year, 1950-51, 1st half-year, 1950-51, 2d half-year, 1951-52, 1st half-year, 1951-52, 2d half-year, 1952-53, 1st half-year, 1952-53, 2d half-year, 1953-54, 1st half-year, 1953-54, 2d half-year, 1954-55, 1st half-year, 1954-55, 2d half-year, 1955-56, 1st half-year, 1955-56, 2d half-year, 1956-57, 1st half-year, 1956-57, 2d half-year, 1957-58, 1st half-year, 1957-58, 2d half-year, 1958-59, 1st half-year, 1958-59, 2d half-year, 1959-60, 1st half-year, 1959-60, 2d half-year, 1960-61, 1st half-year, 1960-61, 2d half-year, 1961-62, 1st half-year, 1961-62, 2d half-year, 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2217-18, 1st half-year, 2217-18, 2d half-year, 2218-19, 1st half-year, 2218-19, 2d half-year, 2219-20, 1st half-year, 2219-20, 2d half-year, 2220-21, 1st half-year, 2220-21, 2d half-year, 2221-22, 1st half-year, 2221-22, 2d half-year, 2222-23, 1st half-year, 2222-23, 2d half-year, 2223-24, 1st half-year, 2223-24, 2d half-year, 2224-25, 1st half-year, 2224-25, 2d half-year, 2225-26, 1st half-year, 2225-26, 2d half-year, 2226-27, 1st half-year, 2226-27, 2d half-year, 2227-28, 1st half-year, 2227-28, 2d half-year, 2228-29, 1st half-year, 2228-29, 2d half-year, 2229-30, 1st half-year, 2229-30, 2d half-year, 2230-31, 1st half-year, 2230-31, 2d half-year, 2231-32, 1st half-year, 2231-32, 2d half-year, 2232-33, 1st half-year, 2232-33, 2d half-year, 2233-34, 1st half-year, 2233-34, 2d half-year, 2234-35, 1st half-year, 2234-35, 2d half-year, 2235-36, 1st half-year, 2235-36, 2d half-year, 2236-37, 1st half-year, 2236-37, 2d half-year, 2237-38, 1st half-year, 2237-38, 2d half-year, 2238-39, 1st half-year, 2238-39, 2d half-year, 2239-40, 1st half-year, 2239-40, 2d half-year, 2240-41, 1st half-year, 2240-41, 2d half-year, 2241-42, 1st half-year, 2241-42, 2d half-year, 2242-43, 1st half-year, 2242-43, 2d half-year, 2243-44, 1st half-year, 2243-44, 2d half-year, 2244-45, 1st half-year, 2244-45, 2d half-year, 2245-46, 1st half-year, 2245-46, 2d half-year, 2246-47, 1st half-year, 2246-47, 2d half-year, 2247-48, 1st half-year, 2247-48, 2d half-year, 2248-49, 1st half-year, 2248-49, 2d half-year, 2249-50, 1st half-year, 2249-50, 2d half-year, 2250-51, 1st half-year, 2250-51, 2d half-year, 2251-52, 1st half-year, 2251-52, 2d half-year, 2252-53, 1st half-year, 2252-53, 2d half-year, 2253-54, 1st half-year, 2253-54, 2d half-year, 2254-55, 1st half-year, 2254-55, 2d half-year, 2255-56, 1st half-year, 2255-56, 2d half-year, 2256-57, 1st half-year, 2256-57, 2d half-year, 2257-58, 1st half-year, 2257-58, 2d half-year, 2258-

- Theory of Numbers:** Professor Sylvester, 1879-80, 2 hra. (8); 1880-81, 2 hra. (6); 1881-82, 1st half-year, 2 hra. (7).
- Theory of Partitions:** Professor Sylvester, 1882-83, 2d half-year, 2 hra. (10).
- Algebra of Multiple Quantity:** Professor Sylvester, 1881-82, 2d half-year, 2 hra. (12); 1883-84, 1st half-year, 2 hra. (6).
- Theory of Substitutions:** Professor Sylvester, 1882-83, 1st half-year, 2 hra. (9).
- Algebraical Geometry and Abelian and Theta Functions:** Professor Cayley, 1881-82, 2d half-year, 2 hra. (14).
- Quaternions:** Dr. Story, 1877-78, 2 hra. (2); 1879-80, 3 hra. (4); 1881-82, 3 hra. (7); 1882-83, 2d half-year, 3 hra. (4).
- Higher Plane Curves:** Dr. Story, 1880-81, 2 hra. (5); 1881-82, 1st half-year, 3 hra. (1); 1883-84, 2 hra. (2).
- Solid Analytic Geometry (General Theory of Surfaces and Curves):** Dr. Story, 1881-82, 2d half-year, 3 hra. (1); 1883-84, 1st half-year, 3 hra. (6).
- Theory of Geometrical Congruences:** Dr. Story, 1882-83, 2d half-year, 2 hra. (4).
- Modern Synthetic Geometry:** Dr. Franklin, 1877-78, 2 hra. (2).
- Theory of Invariants:** Dr. Story, 1882-83, 10 lectures (8); 1883-84, 3 hra. (6).
- Determinants:** Dr. Franklin, 1880-81, 1st half-year, 2 hra. (9); 1882-83, 20 lectures (9).
- Modern Algebra:** Dr. Franklin, 1880-81, 2d half-year, 2 hra. (6); 1881-82, 2d half-year, 2 hra. (6).
- Elliptic Functions:** Dr. Story, 1878-79, 2 hra. (2); 1879-80 (continuation of the previous year's course), 3 hra. (4); Dr. Craig, 1881-82, 3 hra. (8); 1883-84, 3 hra. (4).
- Elliptic and Theta Functions:** Dr. Craig, 1882-83, 3 hra. (10); 1883-84, 3 hra. (8).
- General Theory of Functions, including Riemann's Theory:** Dr. Craig, 1879-80, 30 lectures (2); 1880-81, 1st half-year, 3 hra. (3).
- Spherical Harmonics:** Dr. Craig, 1878-79, 10 lectures (6); 1879-80, 20 lectures (6); 1881-82, 1st half-year, 2 hra. (4); 1883-84, 2d half-year, 1 hr. (4).
- Cylindric or Bessel's Functions:** Dr. Craig, 1879-80, 10 lectures (2).
- Partial Differential Equations:** Dr. Craig, 1880-81, 2d half-year, 2 hra. (5); 1881-82, 2d half-year, 3 hra. (9); 1882-83, 2d half-year, 2 hra. (2); 1883-84, 2d half-year, 2 hra. (4).
- Calculus of Variations:** Dr. Craig, 1879-80, 12 lectures (9); 1881-82, 1st half-year, 2 hra. (8); 1882-83, 1st half-year, 2 hra. (6).
- Definite Integrals:** Dr. Craig, 1876-77, 1st half-year, 3 hra. (5); 1882-83, 1st half-year, 2 hra. (2).
- Mathematical Astronomy:** Dr. Story, 1877-78, 3 hra. (2); 1882-83, 3 hra. (2); 1883-84, 3 hra. (2).
- Elementary Mechanics:** Dr. Craig, 1876-77, 2d half-year (8).
- Statics:** Dr. Franklin, 1882-83, 2d half-year, 3 hra. (5).
- Analytic Mechanics:** Dr. Craig, 1877-78, 1st half-year (6); Dr. Story, 1880-81, 2d half-year, 2 hra. (6); Dr. Craig, 1881-82, 1st half-year, 3 hra. (8); 1882-83, 1st half-year, 3 hra. (4); Dr. Franklin, 1883-84, 3 hra. (6).
- Theoretical Dynamics:** Dr. Craig, 1878-79, 15 lectures (6); 1883-84, 2 hra. (5).
- Mathematical Theory of Elasticity:** Dr. Story, 1876-77, 2d half-year, 2 hra. (4); 1877-78, 2 hra. (2); Dr. Craig, 1881-82, 3 hra. (4); 1883-84, 2d half-year, 2 hra. (3).
- Hydrodynamics:** Dr. Craig, 1878-79, 24 lectures (7); 1880-81, 1st half-year, 2 hra. (6); 2d half-year, 4 hra. (3); 1882-83, 2d half-year, 3 hra. (5).
- Mathematical Theory of Sound:** Dr. Craig, 1883-84, 3 hra. (5).

It may be of interest to give a list of the advanced students of mathematics during the seven years that Sylvester was connected with the Johns Hopkins University, and their present occupation. Dr. Craig and Dr. Franklin are, as we have seen, instructors in mathematics at the Johns Hopkins. The list continues as follows: G. B. Halsted,

professor of mathematics, University of Texas; W. I. Stringham, professor of mathematics, University of California; C. A. Van Velzer, professor of mathematics, University of Wisconsin; O. H. Mitchell, professor of mathematics, Marietta College, Ohio; R. W. Prentiss, in the office of the U. S. Nautical Almanac, Washington; H. M. Perry, instructor in mathematics, Cascadilla School, Ithaca, N. Y.; W. P. Durfee, professor of mathematics, Hobart College, N. Y.; G. S. Ely, examiner, U. S. Patent Office; E. W. Davis, professor of mathematics, University of South Carolina; A. S. Hathaway, instructor in mathematics, Cornell University; G. Bissing, examiner, U. S. Patent Office; A. L. Daniels, instructor in mathematics, Princeton College, 1883-84.

The success in training students for independent research has been very great. To convince himself of this, the reader need only examine the abstracts of papers prepared by students, which have been published in the Johns Hopkins Circulars and in the *American Journal of Mathematics*. Each one of the names given above will be found to appear repeatedly in those publications, as a contributor.

In December, 1883, Professor Sylvester started for England to enter upon his new duties as Savilian professor of geometry in the University of Oxford. The robe of the departing prophet dropped upon the shoulders of Professor Newcomb. No American would have been more worthy of succeeding Sylvester. As an astronomer his name has long shone with a luster which fills with pride every American breast.

Simon Newcomb was born in Wallace, Nova Scotia, in 1835. After being educated by his father he engaged for some time in teaching. He came to the United States at the age of eighteen, and was engaged for two years as teacher in Maryland. There he became acquainted with Joseph Henry, of the Smithsonian Institution, and Julius E. Hilgard, of the U. S. Coast Survey. Recognizing his talent for mathematics, they secured for him, in 1857, a position as computer on the Nautical Almanac, which was then published in Cambridge, Mass. In Cambridge he came under the influence of Prof. Benjamin Peirce. In the catalogues of 1856 and 1857 his name appears as a student of mathematics in the Sheffield Scientific School. He graduated in 1858, and continued as a graduate student for three years thereafter. He was then appointed professor of mathematics in the U. S. Navy, and stationed at the Naval Observatory. He was chief director of a commission created by Congress to direct the transit of Venus in 1874. In that year the Royal Society of London awarded him a gold medal for his *Tables of Uranus and Neptune*. In 1870 he undertook to investigate the errors of Hansen's *Tables*, and compared with observations prior to 1850. The results of this research were published in 1878. In the years 1880 to 1882 he and M. Anderson measured the velocity of light by operations on a large scale and such refined methods as to throw in the shade all other attempts of a similar kind. For the purpose of this measurement they employed and revolving mirrors on opposite shores of the Potomac, at a distance of nearly 4 kilometers.

Since 1877 he has been in charge of the office of the American Ephemeris and Nautical Almanac. Since 1867 that office has been in Washington, instead of Cambridge. Professor Newcomb's predecessor in this office was J. H. O. Coffin, who in 1877 was placed on the retired list, having been senior professor of mathematics in the Navy since 1848.

Professor Newcomb has quite a large corps of assistants in Washington. His researches in astronomy during the last ten or twelve years have been described in the Nation of September 6, 1888, as follows:

"The general object of this work is the determination of the form, size, and position of the orbits of all the large planets of the solar system, from the best and most recent observations, and the preparation of entirely new and uniform tables for predicting the future positions of these objects. The first of the four sections of the work relates to the general perturbations of the planets by each other, and the part already in hand comprises the four inner planets, Mercury, Venus, the Earth, and Mars, in which fourteen pairs of planets come into play. Twelve of these were completed some months since, and only the action of Jupiter on Venus and Mars remained undetermined. In the next place, the older observations of the planets must be recalculated, and thus problems constantly arise which can not be met by general rules. All the observations at Greenwich from 1765 to 1811 have been completely reduced with modern data. Earlier Greenwich observations were similarly treated by Dr. Auwers, of Berlin, who liberally presented the complete calculations as his contribution to the work of the Nautical Almanac Office. In a recent report of this work Professor Newcomb gives further details of his progress in the treatment of other classes of planetary observations.

"Following this collation of all the available observations of each planet, comes the theoretical preparation of their corresponding positions at the time of observation. This forms the most laborious and difficult part of the work; and had Leverrier's tables, the best hitherto, been used without modification, Professor Newcomb would have found it impracticable to complete it with the number of computers at his command; but he has skillfully avoided the difficulty by a reconstruction of Leverrier's work in such form that it should be much less laborious to use, while sufficiently accurate for the purpose required. These theoretical positions must next be compared directly with the observations, one by one, and the differences between the two are then, by suitable mathematical processes, construed as implying the nature and amount of certain corrections to the planet's motion in its orbit. More than a full year must still elapse, says Professor Newcomb, before the work on the four inner planets will have advanced to the stage where this direct comparison is ready to be made. There remain the four outer planets, on the two more important of which, Jupiter and Saturn, Mr. Hill, of the same office, has been engaged for many years, and his new theory

Professor Newcomb studies political economy as a recreation, and every now and then there is a commotion in the camp of political economists, caused by a bomb thrown into their midst by Professor Newcomb, in the form of some magazine article or book.

In 1884 Professor Newcomb added to his duties as superintendent of the Nautical Almanac that of professor of mathematics and astronomy at the Johns Hopkins University. He generally delivers at that institution two lectures per week. The effect of his connection with the mathematical department has been that the mathematical course is more thoroughly systematized and more carefully graded than formerly, and that the attention of students is drawn also to higher astronomy, theoretical and practical. An observatory for instruction is now provided by the university. Besides a telescope of 9½ inches aperture there is a meridian circle with collimators, mercury-basin, and other appliances. Professor Newcomb entered upon his duties at the Johns Hopkins University in 1884 by giving a course of lectures on celestial mechanics. Among other things it embraced his own paper on the "Development of the Perturbative Function and its Derivative in Sines and Co-sines of the Eccentric Anomaly and in Powers of the Eccentricities and Inclinations." The lectures were well attended by the graduate students. At the blackboard Professor Newcomb does not manipulate the crayon with so great dexterity as do his associates, who have been in the lecture-room all their lives, but his lectures are clear, instructive, original, and popular among the students.

Since the departure of Professor Sylvester the following courses of lectures have been given to graduate students:

*Courses of Instruction, Hours per Week, and Attendance, 1884-'88.*

Analytical and Celestial Mechanics: Prof. Newcomb, 1884-'85, 2 hrs. (11).

Practical and Theoretical Astronomy: Prof. Newcomb, 1885-'86, 2 hrs. (9); 1886-'87, 2 hrs. (7).

Theory of Special Perturbations: Prof. Newcomb, 1887-'88, 1st half-year, 2 hrs.

History of Astronomy: Prof. Newcomb, 1887-'88, March and April, 2 hrs.

Computation of Orbits: Prof. Newcomb, 1887-'88, May, 2 hrs.

Theory of Numbers: Dr. Story, 1884-'85, 1st half-year, 2 hrs. (9).

Modern Synthetic Geometry: Dr. Story, 1884-'85, 1st half-year, 3 hrs. (8).

Introductory Course for Graduates: Dr. Story, 1884-'85, 5 hrs. (10); 1885-'86, 5 hrs. (7); 1886-'87, 5 hrs. (10); 1887-'88, 5 hrs.

Modern Algebra: Dr. Story, 1884-'85, 2d half-year, 2 hrs. (9).

Quaternions: Dr. Story, 1884-'85, 2d half-year, 3 hrs. (8); 1886-'87, 3 hrs. (5); 1887-'88, 3 hrs.

Finite Differences and Interpolation: Dr. Story, 1885-'86, 1st half-year, 2 hrs. (5).

Advanced Analytic Geometry: Dr. Story, 1885-'86, 3 hrs. (4); 1886-'87, 2 hrs. (8); 1887-'88, 2 hrs.

Theory of Probabilities: Dr. Story, 1885-'86, 2d half-year, 2 hrs. (5).

Calculus of Variations: Dr. Craig, 1884-'85, 1st half-year, 2 hrs. (5).

Theory of Functions: Dr. Craig, 1884-'85, 3 hrs. (5); 1885-'86, 1st half-year, 3 hrs. (4); 1886-'87, 3 hrs. (6); 1887-'88, 1st half-year, 3 hrs.

Hydrodynamics: Dr. Craig, 1884-'85, 1st half-year, 3 hrs. (6); 1885-'86, 1st half-year, 3 hrs. (4); 1886-'87, 1st half-year, 3 hrs. (4); 1887-'88, 1st half-year, 3 hrs.

of their complicated motion is already in the printer's hands. The two outer planets, Uranus and Neptune, have not yet been begun."

Of Professor Newcomb's labors Professor Cayley has said: "Professor Newcomb's writings exhibit, all of them, a combination on the one hand of mathematical skill and power, and on the other of good hard work, devoted to the furtherance of astronomical science."

His book on Popular Astronomy (1877) is well known. It has been republished in England and translated into German. The treatise on Astronomy by Newcomb and Holden, and their "Shorter Course" on Astronomy, are works which have been introduced as text-books into our colleges almost universally.

Professor Newcomb's scientific work has not been confined to astronomy. He has carried on investigations on subjects purely mathematical. One of the most important is his article on "Elementary Theorems Relating to the Geometry of a Space of Three Dimensions and of Uniform Positive Curvature in the Fourth Dimension," published in Borchardt's Journal, Bd. 83, Berlin, 1877. Full extracts of this very important contribution to non-Euclidian geometry are given in the *Encyclopædia Britannica*, article "Measurement." It is gratifying to know that through Professor Newcomb America has done something toward developing the far-reaching generalizations of non Euclidian geometry and hyper-space. In Volume I of the *American Journal of Mathematics* he has a note "On a Class of Transformations which Surfaces may Undergo in Space of more than Three Dimensions," in which he shows, for instance, that if a fourth dimension were added to space, a closed material surface (or shell) could be turned inside out by simple flexure without either stretching or tearing. Later articles have been on the theory of errors in observations. In former years he also contributed to the *Mathematical Monthly* and the *Analyst*.

Professor Newcomb has written a series of college text-books on mathematics. In 1881 appeared his *Algebra for Colleges* and his *Elements of Geometry*; in 1882 his *Trigonometry and Logarithms*, and *School Algebra*; in 1884 his *Analytical Geometry and Essentials of Trigonometry*; in 1887 his *Differential and Integral Calculus*. These works have been favorably reviewed by the press, and are everywhere highly respected. Professor Newcomb's fundamental idea has been to lead up to new and strange conceptions by slow and gradual steps. "All mathematical conceptions require time to become engrafted upon the mind, and the more time the greater their abstruseness." The student is gradually made familiar in these books with the conceptions of variables, functions, increments, infinitesimals, and limits, long before he takes up the calculus, so in the study of the calculus he is not confronted at the outset and all at once, by a host of new and strange ideas, which suggest already a considerable degree of familiarity with them. The publication of Newcomb's *Algebra* has begun a considerable "reshaping" of the study books in this science, and we now possess works on this subject that are of considerable merit.



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**Modern Algebra:** Dr. Story, 1884-'85, 2d half-year, 2 hrs. (9).

**Quaternions:** Dr. Story, 1884-'85, 2d half-year, 3 hrs. (8); 1886-'87, 3 hrs. (5); 1887-'88, 3 hrs.

**Finite Differences and Interpolation:** Dr. Story, 1885-'86, 1st half-year, 2 hrs. (5).

**Advanced Analytic Geometry:** Dr. Story, 1885-'86, 3 hrs. (4); 1886-'87, 2 hrs. (8); 1887-'88, 2 hrs.

**Theory of Probabilities:** Dr. Story, 1885-'86, 2d half-year, 2 hrs. (5).

**Calculus of Variations:** Dr. Craig, 1884-'85, 1st half-year, 2 hrs. (5).

**Theory of Functions:** Dr. Craig, 1884-'85, 3 hrs. (5); 1885-'86, 1st half-year, 3 hrs. (4); 1886-'87, 3 hrs. (6); 1887-'88, 1st half-year, 3 hrs.

**Hydrodynamics:** Dr. Craig, 1884-'85, 1st half-year, 3 hrs. (6); 1885-'86, 1st half-year, 3 hrs. (4); 1886-'87, 1st half-year, 3 hrs. (4); 1887-'88, 1st half year, 3 hrs.

Linear Differential Equations: Dr. Craig, 1884-'85, 2d half-year, 3 hrs. (3); 1885-'86, 2 hrs. (4); 1887-'88, 2d half-year, 2 hrs.

Theoretical Dynamics: Dr. Craig, 1887-'88, 2d half-year, 2 hrs.

Differential Equations: Dr. Craig, 1887-'88, 2 hrs.

Mathematical Theory of Elasticity: Dr. Craig, 1885-'86, 2d half-year, 3 hrs. (4).

Elliptic and Abelian Functions: Dr. Craig, 1885-'86, 2d half-year, 3 hrs. (4); 1886-'87, 1st half-year, 2 hrs. (6).

Abelian Functions: Dr. Craig, 1887-'88, 2 hrs.

Problems in Mechanics: Dr. Franklin, 1884-'85, 2 hrs. (5); 1885-'86, 2 hrs. (6); 1886-'87, 2 hrs. (5); 1887-'88, 2 hrs.

Since the fall of 1884 Dr. Story has been giving every year an Introductory Course to graduate students, which consists of short courses of lectures on the leading branches of higher mathematics. They are intended to give the student a general view of the whole field, which afterward he is to enter upon and study in its details.

The Johns Hopkins University went into operation primarily as a *University*, giving instruction to students who had graduated from college. A regular college course was, however, organized, and it has been growing rapidly from year to year. In the college the student has the choice between several parallel curricula, which are assumed to be equally honorable, liberal, and difficult, and which therefore lead to the same degree of bachelor of arts. Seven groups have been arranged. Some of them embrace no mathematics at all; but, in those courses where it does enter, the instruction is very thorough. Take, for instance, Dr. Story's lectures on conic sections; the method of treatment is entirely modern, and presupposes a knowledge of determinants. A syllabus has been prepared for the use of the students. The lectures resemble the course given in the work of Clebsch. The student who may have studied such books as Loomis's Analytical Geometry, and who may labor with the conceit that he has mastered analytical geometry and conic sections, will soon discover that he has learned only the A B C, and that he is wholly ignorant of the more elegant methods of modern times.

Connected with the mathematical department of the university has always been a mathematical seminary, which during the time of Sylvester constituted in fact the mathematical society of the university. The meetings were held monthly. In it the instructors and more advanced students would present and discuss their original researches. Care was taken to eliminate papers of little or no value by immature students. Professor Sylvester generally presided. "If you were fortunate," says Dr. E. W. Davis, "you had your paper first on the program. Shorter must be and to the point. Sylvester would be pleased. Then came his paper, or two of them. After him came the rest, but no student understood; Sylvester was dreaming of his own higher flights and who could yet carry him."

Since the time of Newton to this mathematical seminary has been called the Mathematical Society. It is carried on in the same way as before. The mathematical societies proper have since existed, one

conducted by Professor Newcomb, another by Dr. Story, and the third by Dr. Craig. The meetings are held in the evening, and weekly. Each instructor selects for his seminary topics from his special studies; Newcomb, astronomical subjects; Story, geometrical subjects or quaternions; Craig, theory of functions or differential equations. Professor Newcomb's seminary work is closely connected with his lectures. The student elaborates some particular points of the lectures or makes practical application of the principles involved. In one case the computation of the orbit of a comet was taken up. Dr. Story, in the year 1885-86, took up the subject of plane curves for his seminary, and dwelt considerably on quartic and quintic curves, giving matter from Möbius and Zeuthen, and the result of his own study on quintics. The student was expected, if possible, to begin where he had left off and carry on investigations along lines pointed out by him. Dr. Story's talk on this subject in this seminary suggested to one of the students a subject of a thesis for the doctor's degree. In the fall of 1888 Dr. Story began his seminary work with the seventeenth example, p. 103, in Tait's Quaternions. Dr. Craig's seminary has generally been upon subjects in continuation and extension of those upon which he is lecturing at the time. If, for instance, he is lecturing on functions, following the "*Cours de M. Hermite*," he may in his seminary bring up matter from Briot and Bouquet. At other times he has introduced work into his seminary intended to be preparatory to certain advanced courses which he expected to offer.

#### MATHEMATICAL JOURNALS.

The mathematical journals which we are about to discuss were of a much higher grade than those of preceding years. First in order of time is the *Mathematical Miscellany*, a semi-annual publication, edited by Charles Gill. He was teacher of mathematics at the St. Paul's Collegiate Institute at Flushing, Long Island. Eight numbers were published; the first in February, 1836, and the last in November, 1839. Like many other journals of this kind, it had a Junior and Senior department—the former for young students, the latter for those more advanced. The first number was entirely the work of the editor, excepting two or three new problems. Mr. Gill was much interested in Diophantine analysis. In 1848 he published a little book on the Application of Angular Analysis to the Solution of Indeterminate Problems of the Second Degree, which contains some of his investigations on this subject.

Another enthusiastic worker in the field of Diophantine analysis, and a frequent contributor to Gill's journal, was William Lenhart, a favorite pupil of Robert Adrain. Having been afflicted for twenty-eight years with a spasmodic affection of the limbs, occasioned by a fall in early life, which confined him in a measure to his room, he had devoted a considerable portion of his time to Diophantine analysis. To him is

attributed the solution of the problem, to divide unity into six parts such that, if unity be added to each, the sums will be cubes.

The evident defect in Lenhart's processes was their tentative character. In fact, this criticism applies to all work done in Diophantine analysis by American computers, down to the present time. It is true even of old Diophantus himself. To this ancient Alexandrian algebraist, who is the author of the earliest treatise on algebra extant, as well as to his American followers of modern times, general methods were quite unknown. Each problem has its own distinct method, which is often useless for the most closely related problems. It has been remarked by H. Hankel that, after having studied one hundred solutions of Diophantus, it is difficult to solve the one hundred and first. It is to be regretted that American students should have wasted so much time over Diophantine analysis, instead of falling in line with European workers in the theory of numbers as developed by Gauss and others. Previous to the publication of the *American Journal of Mathematics*, our journals contained no contributions whatever on the theory of numbers, excepting the *Mathematical Miscellany*, which had some few articles by Benjamin Peirce and Theodore Strong, which involved Gaussian methods. Among the contributors to the *Mathematical Miscellany* were Theodore Strong, Benjamin Peirce, Charles Avery, Marcus Catlin of Hamilton College, George R. Perkins, O. Root, William Lenhart, Lyman Abbott, jr., B. Docharty, and others.

The next mathematical periodical was the *Cambridge Miscellany of Mathematics, Physics, and Astronomy*, edited by Benjamin Peirce and Joseph Lovering, of Harvard, and published quarterly. The last problems proposed in Gill's journal were solved here. Four numbers only were published, the first in 1842. The list of contributors to this journal was about the same as to the preceding. The most valuable articles were those written by the editors.

During the next fifteen years America was without a mathematical journal; but in 1858, J. D. Runkle, of the Nautical Almanac office in Boston, started the *Mathematical Monthly*. He has since held the distinguished position of professor of mathematics at (and, for a time, president of) the Massachusetts Institute of Technology, where he has been especially interested in developing the department of manual training. As will be seen presently, the time for beginning the publication of a long-lived mathematical journal was not opportune. Three volumes only appeared. On a fly leaf the editor announced to his subscribers that over one third of the subscribers to Volume I discontinued their subscriptions at the close. "I have supposed," he says, "that those who continued their subscription to the second volume would not be so likely to discontinue it to the third volume, and I have made my arrangements accordingly." If, however, any considerable number should discontinue now, it will be subject to very serious loss. • • • I ask as a favor for aid to continue to Volume III, and notify me during

the year if they intend to discontinue at its close. I shall then know whether to begin the fourth volume. I shall not realize a dollar." This announcement discloses obstacles which all our journals that have been dependent entirely upon their subscribers for financial support have had to encounter, and which none except the more recent could long resist. Moreover, the Civil War was now at hand. "On account of the present disturbed state of public affairs, the publication of the *Mathematical Monthly* will be discontinued until further notice." This was the end of the *Monthly*, in 1861.

The salient features in the plan upon which the periodical was conducted, as stated by David S. Hart,\* were: "The publication of five problems in each number, adapted to the capacities of the young students, to be answered in the third succeeding number. The insertion of notes and queries, short discussions and articles of a fragmentary character, too valuable to be lost; and, lastly, essays not exceeding eight pages, on various subjects, in all departments of mathematics. Besides, there were notices and reviews of the mathematical works issued, both old and new. Among the most interesting articles are the account of the comet of Donati, with elegant descriptive plates, written by the astronomical professor of Harvard University (Vol. I, Nos. 2 and 3); a complete catalogue of the writings of John Herschel (Vol. III, No. 7); articles on indeterminate analysis, by Rev. A. D. Wheeler, of Brunswick, Me. (Vol. II, Nos. 1, 6, and 12), and the Diophantine analysis (Vol. III, No. 11). Other articles on the Diophantine analysis by Mr. Wheeler would have been inserted, if the *Mathematical Monthly* had been continued. 'The Economy and Symmetry of the Honey-bees' Cells,' by Chauncey Wright (Vol. II, No. 9). Simon Newcomb gives several interesting 'Notes on Probabilities.' In Vol. II, No. 2, there is an article containing a complete list of the writings of Nathaniel Bowditch, accompanied with short sketches of the same, which is extremely interesting. \* \* \* The periodical is embellished by portraits of N. Bowditch, Prof. Benjamin Peirce, and Sir John Herschel, which are finely executed." The *Monthly* presented a very neat appearance to the eye. In the mathematical notation employed and in the treatment of mathematical subjects, Benjamin Peirce's influence was clearly perceptible. From a scientific point of view, the *Monthly* excelled any of its predecessors.

Since 1861, we had no mathematical periodical in the United States for thirteen years. In January, 1874, was published in Des Moines, Iowa, *The Analyst: A Monthly Journal of Pure and Applied Mathematics*, edited and published by Joel E. Hendricks, a self-taught mathematician. Mr. Hendricks did the printing of the journal himself. It continued until November, 1883. No previous journal of mathematics in this country had been published regularly for so long a time as this. Its long life and beneficial influence are due to a very great extent to

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\* *Analyst*, Vol. II, No. 5, p. 131, Des Moines, Iowa.

the untiring energy and self-sacrificing interest of its editor. Its discontinuance, after nine years, was not due to want of support, but to the failing health and strength of Mr. Hendricks. At first it appeared monthly, afterward bi-monthly.

The list of contributors included the most prominent teachers of mathematics in this country. The names were no longer those found in the *Mathematical Miscellany* or *Cambridge Miscellany*. A new generation of workers had come.

As in previous periodicals, so in this, a great part of each number was devoted to problems. Though the solution of problems is the lowest form of mathematical research, it is, nevertheless, important, not for its scientific, but for its educational value. It induced teachers to look beyond the text-book and to attempt work of their own. The *Analyst* bears evidence, moreover, of an approaching departure from antiquated views and methods, of a tendency among teachers to look into the history and philosophy of mathematics and to familiarize themselves with the researches of foreign investigators of this century. Thus, discussions regarding the fundamental principles of the differential calculus were carried on. Levi W. Meech gave an "Educational Testimony Concerning the Calculus;" W. D. Wilson, of Cornell, gave "A New Method of Finding Differentials;" Joseph Ficklin, of Missouri, showed how one might "find the differential of a variable quantity without the use of infinitesimals or limits;" C. H. Judson, of South Carolina, gave a valuable "investigation of the mathematical relations of zero and infinity," which displayed the wholesome effects of the study of such authors as De Morgan. Judson dealt powerful blows against the reckless reasoning that had been in vogue so long, but, during an occasional unguarded moment, he was hit by his opponents in return. De Volson Wood, of the Stevens Institute, and Simon Newcomb, of Washington, discussed the doctrine of limits.

Another subject considered in the *Analyst* was the possibility of an algebraic solution of equations of the fifth degree. A. B. Nelson, professor of mathematics in Centre College, Danville, Ky., translated from the German an article written in 1861 by Adolph Von Der Schulenburg, entitled, "Solution of the General Equation of the Fifth Degree." The translation and publication of it seem to have been called forth by a statement of W. D. Henkle in the *Educational Notes and Queries*, to the effect that proofs of the impossibility of such a solution had been given by Abel and Wantzel. Nelson's paper was followed by a translation from Serret's *Cours d'Algèbre Supérieure*, by Alexander Evans, of Elkton, Md., of Wantzel's "Demonstration of the Impossibility of Resolving Algebraically General Equations of a Degree Higher than the Fourth." Evans also contributed the (non-algebraic) "Solution of the Equation of the Fifth Degree," translated from the *Theory of Elliptic Functions* of Briot and Bouquet. W. E. Heal, of Wheeling, Ind., followed with an article pointing out the error in Schulenburg's

solution. One might have supposed that this question had now come to a rest, but not so. About two years later T. S. E. Dixon, of Chicago, thought he had found a solution, and he published it in the *Analyst*, but, in the next number, he stated that he had discovered "the weak link in the chain" of its logic.

Of the articles on modern higher mathematics, we mention the "Brief Account of the Essential Features of Grassmann's Extensive Algebra," by W. W. Beman, of Ann Arbor; "Symmetrical Functions, etc.," and "Recent Results in the Study of Linkages," by W. W. Johnson, and an article on determinants by C. A. Van Velzer, of the University of Wisconsin.

Among the historical papers is the very complete and interesting "Historical Sketch of American Mathematical Periodicals," by David S. Hart, of Stonington, Conn.; a "History of the Method of Least Squares," by M. Merriman. Merriman also published Robert Adrain's second proof of the principle.

Among other articles of interest are "Multisection of Angles," and "A Singular Value of  $\pi$ ," by J. W. Nicholson, of The Louisiana State University, at Baton Rouge. The latter article was commented upon by W. W. Johnson, then professor of mathematics in St. John's College, Annapolis, Md., who was a frequent and most gifted contributor to the *Analyst*. Asaph Hall wrote on comets and meteors, George R. Perkins on indeterminate problems, E. B. Seitz on probability. Other important contributors were Daniel Kirkwood, David Trowbridge, Artemas Martin, and G. W. Hill.

Well known among the mathematical public of America is Artemas Martin. Before speaking of his two periodicals we shall briefly sketch his life. This gives us at the same time an opportunity of mentioning many publications which, though not purely mathematical, contained a mathematical department. We can think of few American periodicals of the last thirty years, paying any considerable attention to elementary mathematics, for which Dr. Martin has not been a contributor. Dr. Martin was born in 1835. In 1869 he moved to Erie County, Pa., where he lived on a farm for fifteen years, engaged as a market gardener. He is almost wholly self-taught. His leisure moments were devoted to the study of the "bewitching science." Through the influence of the Hon. W. L. Scott, Member of Congress from Erie, Martin was appointed, in 1885, librarian in the office of the U. S. Coast and Geodetic Survey. He has a large private library containing a very fine collection of American books on mathematics. When the writer was in Washington he enjoyed the great privilege of examining this collection and of seeing many a quaint and curious volume of great rarity.

Martin began his mathematical career when in his eighteenth year, by contributing solutions to the *Pittsburg Almanac* and soon afterward contributed problems to the "Riddler Column" of the *Philadelphia Saturday Evening Post*, and was one of the leading contributors for

twenty years. In 1861 he began contributing problems and solutions to *Clark's School Visitor*, afterward the *School-day Magazine*, published in Philadelphia. In June, 1870, he took charge of the "Stairway Department" as editor, the mathematical part of which he had conducted for some years before. In 1875 he was chosen editor of the department of higher mathematics in the *Normal Monthly*, published at Millersville, Pa., by Edward Brooks. The Monthly was discontinued in 1876. In this journal he published a series of sixteen articles on Diophantine analysis. He contributed to the mathematical department of the *Illinois Teacher* (1865-67); the *Iowa Instructor*, 1865; the *National Educator*, Kutztown, Pa.; the *Yates County Chronicle*, a weekly paper of New York, the mathematical department of which was edited by Samuel H. Wright; *Burnes's Educational Monthly*; the *Maine Farmers' Almanac*; *Educational Notes and Queries*, edited and published by W. D. Henkle, of Ohio. Dr. Martin published thirteen articles on "average" in *Wittenberger*, from 1876 to 1880 inclusive. The mathematical department of this was edited by William Hoover, afterward professor of mathematics in the Ohio University at Athens. Martin's name is familiar also to the readers of the *School Visitor*, a journal started in 1880, and edited and published monthly by John S. Royer in Gettysburg, Darke County, Ohio; of the *Davenport Monthly*, Davenport, Iowa; and of *The Bizarre*, conducted by S. C. and L. M. Gould, in Manchester, N. H. All these journals devoted a portion of their space to mathematics, and to all these Dr. Martin contributed. The mathematics they contained were of course of an elementary kind. He contributed also to English journals on elementary mathematics. Besides the above periodicals we mention the *Railroad Gazette* (New York and Chicago), which contained problems in applied mathematics; the *Mathematician*, edited by Royal Cooper, 1877, and utterly worthless; and the *Wheel*, New York, 1868, of which only one number ever appeared, in which the question was discussed how many revolutions upon its own axis a wheel will make in rolling once around a fixed wheel of the same size.\*

In the spring of 1877 Artemas Martin issued the first number of his *Mathematical Visitor*, which he still continues to publish annually. Although he has never served an hour as apprentice in a printing office to learn the art preservative, he has done all the type-setting for his publications, except that for the first three numbers of the *Visitor*, and has printed all the numbers of the *Visitor* except the first five on a self-inking lever press only 6½ x 10 inches inside of chase. The numbers of the *Visitor* he has printed himself have been pronounced by competent judges to be as fine specimens of mathematical printing as have ever been executed. The *Magazine* he puts in type and gets the presswork

\* For a complete list of journals containing mathematical departments, see *The Teacher's Journal and Queries*, Volume V, No. 12, December, 1888.



done at a printing office, as his press is too small to safely print it, although he printed one number on it."<sup>\*</sup>

Of the Visitor generally six hundred copies have been printed. The list of contributors exceeds one hundred. In the introduction Dr. Martin says: "It was stated nearly three-quarters of a century ago that the learned Dr. Hutton declared that the Ladies' Diary had produced more mathematicians in England than all the mathematical authors in that kingdom." The aim of the Visitor is, if possible, to reach similar results in this country. It is devoted to the solution of problems. They deal more particularly in Diophantine analysis, average, and probability.

In January, 1882, Dr. Martin issued the first number of the *Mathematical Magazine*, which is published quarterly. It was intentionally made more elementary than the Analyst of Mr. Hendricks or the Annals of Mathematics. It was devoted mainly to arithmetic, algebra, geometry, and trigonometry. One of the features is the solution and discussion "of such of the problems found in the various text-books in use as are of special interest, or present some difficulty." Many of the articles found in the Magazine and Visitor came from the pen of the editor himself. Numerous different proofs of the Pythagorean proposition were given in the former, of which we may mention one by James A. Garfield. It was taken from a magazine of 1876 or 1877, and was found pasted on a fly-leaf of an old geometry. It resembles somewhat the old Hindoo proof. Dr. G. B. Halsted contributed several articles on the prismoidal formula. J. W. Nicholson gave a "universal demonstration" of the binomial theorem, without, however, giving a moment's thought to the question of convergency, whenever the series is infinite. William Hoover gave an interesting little article on the history of the algebraic notation. David S. Hart wrote on the history of the theory of numbers, including the indeterminate and Diophantine analysis. He also contributed several articles on the subject last mentioned. A somewhat lengthy discussion was carried on, on the usefulness of logarithms, by P. H. Philbrick, professor of engineering at the State University of Iowa, and H. A. Howe, professor of mathematics at the University of Denver. The former attempted to show that the use of logarithms greatly augmented the labor of "numerical computation" and led to very erroneous results. Some of the calculations in the magazine in which numerical answers are carried to twenty or more decimal places have no value, either educational or scientific. The names of the contributors for the magazine were about the same as for the Visitor.

To show the good that elementary journals like this may do, we give, as an example, the career of E. B. Seitz. He passed his boyhood on a farm, and afterward pursued a mathematical course of two years at the Ohio Wesleyan University. In 1872 he began contributing problems proposed in the "Stairway" department of the School-day

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<sup>\*</sup>The Buffalo Express, August 29, 1886.

Magazine conducted by Dr. Martin. His energies were stimulated, and he became a leading contributor to our periodicals. He astonished his friends by his skill in solving difficult problems, and their admiration for his talents became almost unbounded. His mathematical mind had received the first stimulus from our elementary periodicals. Had he not died in the prime of life, he might have done good original work, provided he had begun to look higher than merely to the solution of difficult problems in our elementary journals. The solving of problems is very beneficial at first, but it becomes a waste of time if one confines himself to that sort of work. The solution of problems is not a high form of mathematical research, and should serve merely as a ladder to more ambitious efforts.

Another journal devoted mainly to the solution of problems is the *School Messenger*, now called the *Mathematical Messenger*, edited and published bi-monthly by G. H. Harvill, at Ada, La. One of the ablest contributors to it is J. W. Nicholson, professor of mathematics at the Louisiana State University. The Messenger commenced February, 1884.

The *Annals of Mathematics* is the continuation, under a new name and different form, of the Analyst. It is edited and published at the University of Virginia by Prof. Ormond Stone and Prof. William M. Thornton. It is of somewhat higher grade than the Analyst, though more elementary than the American Journal of Mathematics. It contains more articles on mathematical astronomy and other subjects of applied mathematics than the American Journal. Our distinguished mathematical astronomer, G. W. Hill, contributes several articles in his specialty. Profs. Asaph Hall, R. S. Woodward, H. A. Howe, and William M. Thornton contribute various articles on applied mathematics. Professor Oliver, of Cornell, has several papers, one on "A Projective Relation among Infinitesimal Elements," and another on the "General Linear Differential Equation." Prof. W. W. Johnson writes on "Glaisher's Factor Tables," the "Distribution of Primes," and other subjects. Professor Halsted gives his demonstration of Descartes's theorem and Euler's theorems. The name of Bohannon, now professor at Ohio University, appears often. Prof. O. H. Mitchell, of Marietta College, discusses the equation of the second degree in two variables. Prof. R. H. Graves has geometrical articles; William E. Heal writes on repetends; S. T. Moreland, on the momental ellipsoid; J. F. McCullogh, on Rolle's theorem. A little space in each number is devoted to the proposing and solving of problems. The list of contributors is too large to be given here in full.

When Professor Sylvester became actively connected with the Johns Hopkins University, in 1877, the university established the *American Journal of Mathematics*, for the publication of original research in pure and applied mathematics. It was the design that this should not be a journal devoted to the publication of solutions to problems, but that it

should be of so high a grade as to command a place by the side of the best European journals of mathematics. It is a source of pride to us that this great aim has been reached. The *American Journal of Mathematics* is to-day as well known and as highly respected in Europe as in America. Among its contributors are found not only the leading scientists of America, but also such foreign investigators as Cayley, Clifford, Crofton, Faà de Bruno, Frankland, De Gasparis, Glashan, Hammond, Hermite, Kempe, Lipschitz, Loudon, Lucas, MacMahon, Muir, Petersen, Poincaré, Roberts, Weichold, and G. P. Young.

The subject which has received most attention in the *American Journal of Mathematics* has been Modern Higher Algebra. The contributions of Sylvester on this subject loom large. In Volume I is found "a somewhat speculative paper" entitled, "An Application of the New Atomic Theory to the Graphical Representation of the Invariants and Covariants of Binary Quantics," followed by appendices and notes relating to various special points of the theory.\* Sylvester contributed various memoirs on binary and ternary quantics, including papers by himself, with the aid of Dr. Franklin, containing tables of the numerical generating functions for binary quantics of the first ten orders, and for simultaneous binary quantics of the first four orders, etc. The list of his articles is too extensive to be mentioned here. Since his return to England he has contributed to the Journal a series of "Lectures on the Theory of Reciprocants," reported by J. Hammond.

The larger number of American contributions are from persons who were, or still are, connected with the Johns Hopkins University, either as teachers or students. Dr. W. E. Story, of the Johns Hopkins University, has written on "Non-Euclidean Trigonometry," "Absolute Classification of Quadratic Loci, etc.," and other, chiefly geometrical, subjects. Dr. T. Craig has contributed numerous papers, mainly on the theory of functions and differential equations. Dr. F. Franklin has aided Professor Sylvester in the preparation of papers, and has also made various independent contributions. After the return to England of Professor Sylvester, Professor Newcomb became editor-in-chief. His valuable articles have been noticed elsewhere. Among the contributors who were once students at the Johns Hopkins University, but are now not connected with it, are E. W. Davis, W. P. Durfee, G. S. Ely, G. B. Halsted, A. S. Hathaway, O. H. Mitchell, W. I. Stringham, O. A. Van Velzer, A. L. Daniels, O. Veneziani, D. Barcroft, and J. O. Fields. The Journal has two lady contributors, Mrs. C. Ladd Franklin, of Baltimore, and Miss C. A. Scott, of Bryn Mawr College. The great memoir on "Linear Associative Algebra," by Benjamin Peirce, was published in the *American Journal of Mathematics*; also articles by his son, C. S. Peirce, on the "Algebra of Logic" and the "Ghosts in Diffraction Spectra." Papers on applied mathematics have been written by Professor Rowland, of the Johns Hopkins University, and George

\* Vide Professor Cayley's article on Professor Sylvester in *Nature*, January 3, 1889.

William Hill, of the Nautical Almanac Office. Mr. Hill has done admirable work in mathematical astronomy. For his researches on the lunar theory, published in the *American Journal*, and for other astronomical papers, published elsewhere, he was awarded the gold medal of the Royal Astronomical Society, in 1887.\* Among the writers for the *American Journal* is Prof. W. W. Johnson, of the U. S. Naval Academy at Annapolis. He is also a frequent contributor to leading European journals, and commands a place among the very foremost of American mathematicians. In the list of American writers to the *Journal* are H. T. Eddy, J. W. Gibbs, E. McClintock, A. W. Phillips, J. Hagen, E. W. Hyde, H. B. Fine, and others of no less power and originality.

#### THE U. S. COAST AND GEODETIC SURVEY.

In giving the origin of the U. S. Coast Survey it is desirable to begin with a sketch of the preliminary training of its first superintendent, Ferdinand R. Hassler. He was born in the town of Aarau, Switzerland, in 1770. He was sent to the University of Bern to study law, but he soon drifted into mathematics and became a favorite pupil of Prof. John G. Tralles.† Tralles and Hassler undertook the topographical survey of the Canton of Bern. In 1791 a base-line was measured, and a net of triangles established. The instruments on hand being found insufficient for long distances new ones were ordered from Bamaden, in London. On the receipt of these, in 1797, the survey was resumed, but soon discontinued. The conquering armies of the French came marching into Switzerland. The feeble republic was forced to submit to the dictatorial orders of the war minister of France, which required, among other things, that the places then occupied by the Swiss engineers should be vacated and filled by French. A swarm of sixty French engineers appeared, but soon disappeared without accomplishing anything. The revolutionary tendencies of the times and the unsettled state of the country induced Hassler to quit Switzerland. His fatherland seemed to bear no roses for him. Having landed in Philadelphia, in October, 1805, he formed the acquaintance of Prof. Robert Patterson and Mr. Garnet, of New Brunswick, to whom he showed his mathematical books and instruments.

About this time Congress was considering the feasibility of a survey of the coasts and harbors. Professor Patterson sent to President Jefferson a sketch of Hassler's scientific career in Switzerland, and Mr. Clay, the Representative from Philadelphia, in 1806, asked Hassler whether he would be willing to undertake the survey, in case that the

\* *Philosophical Notices on the Royal Astronomical Society*, Vol. XLVII, No. 4, February, 1887.

† Translation from the German of *Memoirs of Ferdinand Rudolph Hassler*, by Emil Zehleker, published in Aarau, Switzerland, 1877, with Supplementary Documents, published in Nice, 1874.

Government should decide upon one. Mr. Hassler was, of course, willing. The law authorizing the survey was passed in February, 1807. Hassler received one of the twelve circulars which were sent to scientific men for plans of the contemplated survey. By the direction of President Jefferson, a commission (formed, it appears, of the very gentlemen who had proposed plans, excepting Mr. Hassler) examined the various plans at Professor Patterson's, in Philadelphia. They rejected their own projects and recommended to the President the one suggested by Mr. Hassler. The survey proposed by him was of a kind that had never been previously attempted in this country; it was to be a *triangulation*, and the sides of the triangles were to be from ten to sixty miles in length, such as had, at that time, just been executed in France and was in progress in England. The project was quite in advance of the science of our country. It was fortunate for us that a man of Mr. Hassler's learning, ability, and mechanical ingenuity was available to the Government. He had, meanwhile, been appointed by Jefferson professor at West Point. This position he resigned after three years, and accepted the professorship of mathematics at Union College, Schenectady, N. Y. Politics delayed the work of the survey. The first thing to be done was to procure the necessary instruments. In 1811 Hassler was sent to England by our Government to direct the manufacture of suitable instruments. Shortly after his arrival in Great Britain the War of 1812 broke out, and he was four years in London, in the disagreeable position of an alien enemy, and half the time left by our Government without compensation. He returned to this country in 1814, with a splendid collection of instruments, which had cost nearly forty thousand dollars.

In August, 1816, a formal agreement between the Government and Mr. Hassler was reached, to the effect that he should undertake the execution of the survey. He immediately entered upon the preliminary steps of reconnoitering and the numerous collateral experiments necessary for such a survey. Two preliminary base-lines were measured: One in New Jersey, in the rear of the Highlands, on North River, and nearly six miles in length; the other on Long Island, and of about five miles. Down to the year 1818 eleven stations were occupied, forming the elements of 124 triangles.

To a scientific man, familiar with the many preliminary details which are indispensable to accurate scientific work, but which do not always appear in the ultimate results, the progress which Hassler was making would have seemed highly satisfactory. Congress, however, was displeased. In April, 1818, Mr. Hassler received official notice that he was suspended, accompanied with the remark that the little progress hitherto made in the work had caused general dissatisfaction in Congress. Possibly the feeling on the part of American engineers against this foreigner because he had been preferred to one of them had something to do with this suspension. To Hassler this was a very severe blow; his

brightest hopes seemed dashed into fragments. A year or two later he prepared a defense of himself. He wrote an account of his plans and methods and published it in the *Philosophical Transactions of Philadelphia* (Vol. III, New Series, 1825). By this article he hoped to vindicate his schemes. It attracted the attention of scientific men everywhere. It was reviewed by leading astronomers in Europe—Bessel, Struve, Schumacher, Férussac, Francœur, Krusenstern, and others—all agreeing that Mr. Hassler's plans were good, and testifying to his inventive genius for solving the difficulties of the Coast Survey, as well as to the certainty that his plans, if carried out, would lead to success. Bessel was certainly a competent judge, for, in addition to his theoretical knowledge, he had had experience in geodetic work in Germany. He had words of only the highest praise for Hassler's scheme.\*

After his suspension from the survey, Hassler engaged in various occupations. For a while he was a farmer in northern New York. He afterward went to Jamaica, Long Island, and then to Richmond, Va., giving lessons in mathematics to sons of prominent men. While in Richmond he published his *Elements of the Geometry of Planes and Solids*, 1828. His *Elements of Analytic Trigonometry* appeared in 1826. Subsequently he published an *Arithmetic, Astronomy, and Logarithms and Trigonometric Tables*, with introductions in five languages.

After twelve years in rural retreat, Hassler was recalled to official activity. He became United States gauger, and then was intrusted, from 1830 to 1832, with the difficult mission of regulating the standards of weights and measures throughout the United States, which at that time were very various.

In 1828 the question of the Coast Survey was again agitated. The Secretary of the Navy reported to Congress favorably on Hassler's work, which had been suspended so suddenly ten years previously. The Secretary said that "he [Hassler] had accomplished all that was possible in so short a time." In 1832 Mr. Hassler was re-instated, with the title of "Superintendent of the United States Coast Survey."

In the interval from 1818 to 1832 nothing of permanent value had been accomplished. Attempts had been made to survey portions of the coast, under the direction of the Navy Department, but there had been no general or connected survey. The charts prepared had been expensive and unsafe, and not very creditable to the country.

In 1832 began the most successful and most famous period in Mr. Hassler's life. Though sixty-two years old, there still glowed in him the fire of youth. The survey was begun with vigor. He had a traveling carriage prepared for him, which conveyed him rapidly to all parts of the survey. In this carriage he could seat himself at a writing table or dispose himself for sleep. The work was prosecuted according to the plans first laid out by him. He labored under the great disadvantage of having no skilled assistants. His corps of workmen had all to be

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\* *Forster's Journal*, Vol. IX, p. 225.

trained and educated to the refined methods which he was introducing. The work of the survey had to be *systematized*. It continued under his direction until the time of his death, in 1843. He left the work well advanced between Narragansett Bay and Cape Henlopen, and the survey sufficiently organized in all its varied details. His course was, however, frequently criticised in Congress, and it was not always easy to get the necessary appropriations.

Mr. Hassler was very self-confident and independent. This was one cause of the occasional opposition to him. Though not conceited, he was conscious of his superiority over the great mass of men with whom he came in contact in Washington. The following anecdote is characteristic of him: At one time the cry of "retrenchment and reform" had become popular, and a newly appointed Secretary of the Treasury thought he could not signalize his administration more aptly than by reducing the large salary of the superintendent. He sent for Mr. Hassler and said, "My dear sir, your salary is enormous; you receive \$6,000 per annum—an income, do you know, quite as large as that of the Secretary of State." "True," replied Hassler, "precisely as much as the Secretary of State and quite as much as the Chief of the Treasury; but do you know, Mr. Secretary, that the President can make a minister of State out of anybody; he can make one even out of you, sir; but if he can make a Hassler, I will resign my place."

Hassler's successor was Alexander Dallas Bache, a great-grandson of Franklin and a graduate of West Point. He exercised a very marked influence over the progress of science among us. He graduated at the head of his class, and the great expectations that were then entertained of him have been fully realized. For eight years he devoted himself to physical science, while professor at the University of Pennsylvania, and gained a wide reputation. The Coast Survey made rapid progress under his management. Congress began to show better appreciation of this sort of work, and made more liberal appropriations. This enabled him to adopt a more comprehensive scheme. Instead of working only at one locality, as had been done previously, he was able to begin independent surveys at several places at once, each section employing its own base. He proposed eight sections, which number was increased on the annexation of Texas, and again on the annexation of California.

Two of the most important improvements of modern geodesy were perfected and brought into use at the beginning of Bache's superintendency, namely, Mr. Talbott's method of determining latitudes and the telegraphic method of determining longitude. Various other refinements in every branch of work were introduced. Systematic observations of the tides, a magnetic survey of the coast, and the extension of the hydrographic explorations into the Gulf Stream were also instituted by Bache.

Having extended the scope of the Survey, Bache needed a greater number of assistants, but the supply was not wanting. Says Prof. T.

H. Safford,\* "he found available for its higher geodetic works a number of West Point officers, of whom T. J. Lee was one, and Humphreys, afterward chief engineer of the Army, another. One of the leaders in practical astronomy of the topographical engineers was J. D. Graham; and the work which had been done by that corps upon the national and State boundaries had familiarized a good many Army officers with field astronomy and geodesy.

"Bache, who had been out of the Army nearly twenty years employed his great organizing and scientific capacity in training the Coast Survey corps (including detailed Army officers) into practical methods for its various problems; and the connection between the West Point officers and the able young civilians, who are now the veterans of the Survey, was extremely wholesome.

"Lee prepared a work (Tables and Formulae) which has served an excellent purpose in bridging the gap between theory and practice; especially for the last generation of West Point officers."

Graduates of West Point are now more closely employed in military and other public duty, and are no longer employed in the Coast Survey.

The work of the Survey was interrupted by the Civil War. Soon after its close Bache died (1867). Benjamin Peirce, his successor in the superintendency, said of him: "What the Coast Survey now is, he made it. It is his true and lasting monument. It will never cease to be the admiration of the scientific world. \* \* \* It is only necessary conscientiously and faithfully to follow in his foot-steps, imitate his example, and develop his plans in the administration of the Survey."

Under Peirce, the survey of the coasts was pushed with vigor, and it rapidly approached completion. He proposed the plan of connecting the survey on the Atlantic Coast with that on the Pacific by two chains of triangles, a northern and a southern one. This project received the sanction of Congress, and thus the plan of a general geodetic survey of the whole country was happily inaugurated.

Benjamin Peirce's successor on the Coast Survey was Carlisle Pollock Patterson. He was a graduate of Georgetown College, Kentucky, and had for many years previous to this appointment, in 1874, been connected with the Survey as hydrographic inspector. Under him the extension of the Survey into the interior of our country, as inaugurated by Peirce, was continued. By the completion of this work this country will contribute its fair share to the knowledge of the figure of the earth, which has hitherto been derived entirely from the researches of other nations. On account of this extension, the name, "U. S. Coast Survey," was changed, in 1879, to "U. S. Coast and Geodetic Survey."

Patterson died in 1881, and Julius Erasmus Hilgard became his successor. Hilgard was born in Zweibrücken, Bavaria, came to this country at the age of ten, and at the age of twenty was invited by Bache to become one of his assistants on the Survey. Hilgard soon came to be

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\*Mathematical Teachings, p. 6.



recognized for great ability and skill, and rose to the position of assistant in charge of the Office in Washington. He held the superintendency from 1881 to 1885, when he resigned. His work consisted chiefly of researches and discussions of results in geodesy and terrestrial physics, and in the perfecting of the methods and instruments employed. The superintendency was next intrusted to Frank M. Thorn, who was succeeded in July, 1889, by T. C. Mendenhall, who now fills the office.

The work of the U. S. Coast Survey has been carried on with great efficiency from its very beginning, and reflects great credit upon America. In making the computations for the Survey, the method of least squares for the adjustment of observations has found extended application. Valuable papers on this subject by Bache and Schott have been printed in the reports of the U. S. Coast Survey.\* Charles A. Schott graduated at the Polytechnic School in Karlsruhe, came to this country in 1848, and has since that time been an efficient worker on the U. S. Coast Survey. He is now chief of the computing division.

It will be remembered that interesting researches on least squares had been made quite early in this country by Robert Adrain. Benjamin Peirce invented a criterion for the rejection of doubtful observations.† It proposes a method for determining, by successive approximations, whether or not a suspected observation may be rejected. Tables are needed for its application. Objections have been made to its use, because it "involves a contradiction of reasoning."‡ The criterion is given by Chauvenet in his *Method of Least Squares* (1864), and has been used to some extent on the U. S. Coast Survey, but it has found no acceptance in Europe. Chauvenet gives an approximate criterion of his own for the rejection of one doubtful observation, which is derived, he says, "directly from the fundamental formula upon which the whole theory of the method of least squares is based." But this criterion, too, has been criticised as being "troublesome to use, and as based on an erroneous principle." Stone, in England, offered still another criterion for the rejection of discordant observations, but Glaisher pronounces it untrustworthy and wrong. No criterion has yet been given which has met with general acceptance. Indeed, Professor Newcomb considers it impossible that such a one should ever be invented. Says he (in his second paper mentioned below): "We here meet the difficulty that no positive criterion for determining whether an observation should or should not be treated as abnormal is possible. Several attempts have indeed been made to formulate such a criterion, the best known of which is that of Peirce."

\* See reports for the years 1850, '55, '56, '57, '61, '64, '66, '67, '75.

† Gould's *Astronomical Journal*, Vol. II, pp. 161-3.

‡ See Prof. Mansfield Merriman's article in the *Transactions of the Connecticut Academy*, containing a list of writings relating to the method of least squares and the theory of the accidental errors of observation, which comprises 406 titles by 193 authors.

Valuable papers on least squares have been contributed in this country by G. P. Bond,\* of Harvard; Simon Newcomb,† C. S. Pierce,‡ and Truman H. Safford.§ The text-books on this subject generally used in our schools are those of Chauvenet, Merriman, and T. W. Wright.

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\*"On the use of Equivalent Factors in the Method of Least Squares," *Memoirs American Academy*, Vol. VI, pp. 179-212.

†"A Mechanical Representation of a Familiar Problem," *Monthly Notices of the Astronomical Society*, London, Vol. XXXIII, pp. 573-4; "A Generalized Theory of the Combination of Observations so as to Obtain the Best Results," *American Journal of Mathematics*, Vol. VIII.

‡"On the Theory of Errors of Observations," *Report U. S. Coast Survey*, 1878, pp. 200-224.

§"On the Method of Least Squares," *Proceedings American Academy*, Vol. XI.

#### IV.

#### THE MATHEMATICAL TEACHING AT THE PRESENT TIME.

The mathematical teaching of the last ten years indicates a "rupture" with antiquated traditional methods, and an "alignment with the march of modern thought." As yet the alignment is by no means rectified. Indeed it has but barely begun. The "rupture" is evident from the publication of such works as Newcomb's series of mathematical textbooks, recent publications on the calculus, the appearance of such algebras as those of Oliver, Wait, and Jones, Phillips and Beebe, and Van Velzer and Slichter; of such geometries as Halsted's "Elements" and "Mensuration;" of such trigonometries as Oliver, Wait, and Jones's; of Carll's Calculus of Variations; Hardy's Quaternions; Peck's and Hannus's Determinants; W. B. Smith's Co-ordinate Geometry (employing determinants); Craig's Linear Differential Equations.

Determinants and quaternions have thus far generally been offered as elective studies, and have formed a crowning pinnacle of the mathematical courses in colleges. It is certainly very doubtful whether this is their proper place in the course. It seems quite plain that the elements of determinants should form a part of algebra, and should be taught early in the course, in order that they may be used in the study of co-ordinate geometry. What place should be assigned to quaternions is not quite so plain. Prof. De Volson Wood introduces their elements in his work on co-ordinate geometry. The professors of Cornell have not taught quaternions directly for some years, but are convinced that most students derive more benefit by a mixed course in matrices, vector addition and subtraction, imaginaries, and theory of functions. The early introduction of determinants seems more urgent than that of quaternions. We think, however, that great caution should be exercised in incorporating either of these subjects in the early part of mathematical courses. Those universities and colleges which are, as yet, not strong enough to maintain a high and rigid standard of admission, and whose students enter the Freshman class with only a very meagre and superficial knowledge of the *elements* of ordinary algebra, would find the introduction of determinants and imaginaries as Freshman studies a hazardous innovation. One of the very first considerations in mathematical teaching is *thoroughness*. In the past the *lack* of thoroughness has poisoned the minds of the American youth with an utter dislike and bitter hatred of mathematics. Whenever a subject is not well understood, it is not liked; whenever it is well understood, it is generally

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There is almost always some one author whose text-books reach very extended popularity among the great mass of schools. Such authors were Webber, Day, Davies, and Loomis. If we were called upon to name the writer whose books have met with more wide-spread circulation during the last decennium than those of any other author we should answer, Wentworth. Mr. Wentworth was born in Wakefield, N. H., fitted for college at Phillips Exeter Academy, graduated at Harvard College in 1858, and then returned to Phillips Exeter Academy, where he has been ever since. He had for instructors in mathematics, at the academy, Prof. Joseph G. Hoyt, afterward chancellor of the Washington University in St. Louis; and, in college, Prof. James Mills Peirce. "The characteristics of my books," says Mr. Wentworth, "are due to what I have found from a long experience is absolutely necessary in order that a pupil of ordinary ability might master the subject of his reading. To learn by doing, and to learn one step thoroughly before the next is attempted, constitute pretty much the whole story." In point of scientific rigor Wentworth's books are superior to the popular works of preceding decades. It seems to us that the book most liable to criticism is his *Elementary Geometry* (old edition). He has been greatly assisted in the writing of his books by leading teachers from different parts of our country. Some of the books bearing his name are almost entirely the work of other men.

It is to be hoped that the near future will bring reforms in the mathematical teaching in this country. We are in sad need of them. From nearly all our colleges and universities comes the loud complaint of inefficient preparation on the part of students applying for admission; from the high schools comes the same doleful cry. Errors in mathematical instruction are committed at the very beginning, in the study of arithmetic. Educators who have studied the work of Prussian schools declare that our results in elementary instruction are far inferior. Says President C. K. Adams, of Cornell University: "In the lowest grades of schools our inferiority seems to me to be very marked. The results of the earliest years of the European course, I mean those devoted to teaching the boy, say from the time he is nine years of age until he is fourteen, when compared with the fruits of the courses pursued during the corresponding years in the average American school, are immeasurably superior." President Adams institutes a comparison between Brooklyn and Berlin schools. Speaking of a Brooklyn boy of fifteen, he remarks: "In the first place it must be said that he has had forced upon him six hours a week in arithmetic, during the whole of the seven primary grades. Then on emerging from the primary school, and coming into the grammar school, he is required to take an average of four hours a week in the same study, during all the eight grades. That is to say, during the whole of the boy's career in school, from the

\* New England Association of Colleges and Preparatory Schools; *Addresses and Proceedings at the Annual Meeting, 1887*, p. 24.

time he is seven until he is fifteen, he has devoted no less than five hours a week of recitations to the study of arithmetic alone. If we deduct the hours devoted to reading, penmanship, and music, we find that five-elevenths of what remains is devoted to arithmetic. Making no deductions, and including the hours devoted to the elementary work requiring no preparation whatever, we find that arithmetic occupies in the class-room considerably more than one-fourth of all the student's time, during the whole of seven or eight years."

This statement is applicable with equal force to probably all our schools. The fact is that the study of arithmetic has been, in one sense, greatly overdone in this country. The most melancholy thought in this connection is that, after all, our boys and girls acquire only a deficient knowledge of this subject. Persons who had opportunity for comparison assure us that the American boy does not "figure" as rapidly and accurately as the German boy.

If the above assertions be true, then it behooves the American teacher to inquire wherein the foreign methods of teaching excel his own. In some circles the study of pedagogy has not been popular. This apathy is, we think, partly due to the influence of *some* of our normal schools. Many of our normal schools have been conducted very efficiently, but others have had teachers in their faculties who lacked breadth and depth of scholarship, and who brought the study of pedagogy into disrepute by their narrowness and their lack of elasticity in the application of methods. This aversion to the study of theories of teaching is now happily disappearing. Our universities and colleges are beginning to establish chairs of pedagogy.

Improvements in the teaching of arithmetic might probably be effected by the general introduction of some such method as that of Grube. The first complete exposition of this method was, we believe, published in this country by F. L. Soldan, formerly principal of the St. Louis Normal School. It seems to gain ground here every year.

A most valuable and suggestive monograph on mathematical teaching has been written by Prof. T. H. Safford, of Williams College. Professor Safford is an advocate of the *heuristic method* of teaching. Grube is the representative of this in arithmetic. The method employed by Spencer in his little book on *Inventional Geometry* is similar to the heuristic, if not identical with it. The heuristic is, in general, the method in which the pupil's mind does the work. It is a slow method. Thus, Grube considers the numbers from 1 to 10 sufficient to engage the attention of a child (of six or seven years) during the first year of school. "In regard to extent, the scholar has not, apparently, gained very much—he knows only the numbers from 1 to 10. But he knows them."\* The Germans "make haste slowly," but in elementary education they beat us in the race. Geometry, like arithmetic, should be taught sparingly at a time, but for many years in succession. Profes-

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\* Grube's method, by F. Louis Soldan, p. 21.

Mr Safford strongly recommends the parallelism of the two main mathematical subjects—arithmetic including algebra, and geometry including trigonometry and conic sections. Thereby the study of algebra and geometry can be extended over a longer period of time. According to his ideal programme of study, primary arithmetic is accompanied by notions of form and drawing; arithmetic through rule of three, by rudiments of geometry; universal arithmetic and simple equations, by one or two books in plane geometry; algebra through quadratics, by plane geometry; advanced algebra, by solid geometry, conic sections, plane trigonometry, etc.

"Of course this programme is somewhat variable, but the main principle, that a course of arithmetic must run parallel with one of geometry from the beginning of a school course to the end, is one which is laid down by the best educators since Pestalozzi's time."<sup>o</sup>

In order to enable the writer to give a view of the present condition of mathematical teaching, the Bureau of Education sent to various universities, colleges, normal schools, academies, institutes, and high schools, a printed letter with a series of questions to be answered. We give a list of the institutions which sent in replies, and state the results as fully as our space will permit.<sup>†</sup>

#### STATISTICS ILLUSTRATING THE PRESENT CONDITION OF MATHEMATICAL INSTRUCTION IN THE UNITED STATES.

##### (a) UNIVERSITIES AND COLLEGES.

|    | Name of institution.                                                | Location.            | Name of person reporting. | Title or position of person reporting.                      |
|----|---------------------------------------------------------------------|----------------------|---------------------------|-------------------------------------------------------------|
| 1  | University of Alabama...                                            | Tuscaloosa, Ala..... | T. W. Palmer.....         | Professor of mathematics.                                   |
| 2  | Spring Hill College.....                                            | Mobile, Ala.....     | A. S. Wagner.....         | Do.                                                         |
| 3  | Central Female College...                                           | Tuscaloosa, Ala....  | S. B. Foster.....         | President.                                                  |
| 4  | Alabama Polytechnic Institute, Agricultural and Mechanical College. | Auburn, Ala.....     | O. D. Smith.....          | Professor of mathematics.                                   |
| 5  | Huntsville Female College                                           | Huntsville, Ala..... | A. B. Jones.....          | President.                                                  |
| 6  | Talladega College.....                                              | Talladega, Ala.....  | James Bailey.....         | Principal.                                                  |
| 7  | Alabama Conference Female College.                                  | Freshburg, Ala.....  | John Manney.....          | President.                                                  |
| 8  | Pierce Christian College...                                         | College City, Cal..  | D. E. Hughes.....         | Professor of mathematics, astronomy, and civil engineering. |
| 9  | St. Ignace College.....                                             | San Francisco, Cal.  | T. C. Leonard.....        | Teacher of higher mathematics.                              |
| 10 | State Agricultural College                                          | Fort Collins, Colo.  | V. E. Stulbrand...        | Professor of mathematics and master of literary science.    |
| 11 | University of Denver...                                             | Denver, Colo.....    | H. A. Howe.....           | Professor of mathematics and astronomy.                     |

<sup>o</sup> Monograph on Mathematical Teaching by T. H. Safford, p. 44.

<sup>†</sup> From this list are omitted some few reports which were sent in too late for insertion, or which did not give the name of the institution or the person reporting, or which were illegible.

(a) UNIVERSITIES AND COLLEGES—Continued.

|    | Name of institution.                 | Location.             | Name of person reporting.                | Title or position of person reporting.                           |
|----|--------------------------------------|-----------------------|------------------------------------------|------------------------------------------------------------------|
| 12 | University of Colorado...            | Boulder, Colo.....    | I. M. De Long.....                       | Professor of mathematics.                                        |
| 13 | State School of Mines ....           | Golden, Colo.....     | Paul Meyer.....                          | Do.                                                              |
| 14 | Storrs Agricultural School           | Storrs, Conn.....     | W. F. Washburn..                         | Professor of chemistry and mathematics.                          |
| 15 | Trinity College.....                 | Hartford, Conn.....   | F. S. Luther.....                        | Professor of mathematics and astronomy.                          |
| 16 | University of Dakota.....            | Vermillion, Dak....   | L. S. Hulburt.....                       | Professor of mathematics.                                        |
| 17 | Dakota School of Mines ..            | Rapid City, Dak....   | L. L. Conant.....                        | Do.                                                              |
| 18 | Georgetown College.....              | Washington, D. C....  | J. F. Dawson.....                        | Professor of physics and mechanics.                              |
| 19 | National Deaf-Mute College.          | ...do.....            | { Joseph C. Gordon<br>A. G. Draper.....  | Professor of mathematics.<br>Assistant professor of mathematics. |
| 20 | Howard University.....               | ...do.....            | G. W. Cook.....                          | Tutor in mathematics.                                            |
| 21 | De Land University.....              | De Land, Fla.....     | R. Gentry.....                           | Teacher of mathematics.                                          |
| 22 | Seminary West of the Suwannee River. | Tallahassee, Fla....  | G. M. Edgar.....                         | President and professor of mathematics and natural sciences.     |
| 23 | Florida State Agricultural College.  | Lake City, Fla.....   | L. H. Orleman.....                       | Professor of mathematics.                                        |
| 24 | Bowdon College.....                  | Bowdon, Ga.....       | C. O. Stubbs.....                        | Do.                                                              |
| 25 | North Georgia Agricultural College.  | Dahlonega, Ga.....    | W. S. Wilson.....                        | Do.                                                              |
| 26 | Hearn Institute.....                 | Cave Spring, Ga....   | E. T. Whatley.....                       | President.                                                       |
| 27 | University of Georgia....            | Athens, Ga.....       | W. Rutherford....                        | Professor of mathematics.                                        |
| 28 | Eureka College.....                  | Eureka, Ill.....      | G. A. Miller.....                        | Do.                                                              |
| 29 | Illinois State Normal University.    | Normal, Ill.....      | J. W. Cook.....                          | Instructor in mathematics.                                       |
| 30 | Lombard University.....              | Galesburg, Ill.....   | J. V. N. Standish..                      | Professor of mathematics and astronomy.                          |
| 31 | M'Kendree College.....               | Lebanon, Ill.....     | A. G. Jepsen.....                        | Professor of mathematics.                                        |
| 32 | German-English College..             | Galena, Ill.....      | Fr. Schaub.....                          | President.                                                       |
| 33 | Lincoln University.....              | Lincoln, Ill.....     | J. W. P. Buchanan..                      | Professor of mathematics.                                        |
| 34 | Lake Forest University ..            | Lake Forest, Ill..... | M. McNeill.....                          | Professor of mathematics and astronomy.                          |
| 35 | University of Illinois....           | Urbana, Ill.....      | { S. W. Shattuck ..<br>S. H. Peabody.... | Professor of mathematics.<br>Regent (president).                 |
| 36 | Illinois College.....                | Jacksonville, Ill.... | J. H. Pratt.....                         | Ph. D.                                                           |
| 37 | North-Western College...             | Naperville, Ill.....  | H. F. Kleinsing....                      | Professor of mathematics.                                        |
| 38 | Indiana University.....              | Bloomington, Ind....  | J. Swain.....                            | Do.                                                              |
| 39 | Wabash College.....                  | Crawfordsville, Ind.. | J. Norris.....                           | Do.                                                              |
| 40 | Kearlham College.....                | Richmond, Ind.....    | W. B. Morgan.....                        | Do.                                                              |
| 41 | Ross Polytechnic Institute.          | Terre Haute, Ind....  | C. A. Waldo.....                         | Do.                                                              |
| 42 | De Pague University.....             | Greencastle, Ind....  | A. Martin.....                           | President.                                                       |
| 43 | Franklin College.....                | Franklin, Ind.....    | R. J. Thompson....                       | Professor of mathematics.                                        |
| 44 | Indiana Normal College ..            | Covington, Ind.....   | O. E. Coffin.....                        | Do.                                                              |
| 45 | Hanover College.....                 | Hanover, Ind.....     | F. L. Morse.....                         | Professor of mathematics.                                        |
| 46 | State University of Iowa.            | Iowa City, Iowa....   | L. G. Weld.....                          | Acting professor of mathematics.                                 |
| 47 | University of Des Moines.            | Des Moines, Iowa...   | T. M. Blakalee....                       | Ph. D., Yale, 1888.                                              |
| 48 | Oakaleosa College.....               | Oakaleosa, Iowa....   | J. A. Beattie.....                       | President.                                                       |
| 49 | Upper Iowa University ..             | Fayette, Iowa.....    | J. W. Breckell.....                      | Do.                                                              |

## (a) UNIVERSITIES AND COLLEGES—Continued.

|    | Name of institution.                                  | Location.                       | Name of person reporting.      | Title or position of person reporting.          |
|----|-------------------------------------------------------|---------------------------------|--------------------------------|-------------------------------------------------|
| 80 | Oswego College for Young Ladies.                      | Oswego, Kan.....                | S. H. Johnson.....             | Principal.                                      |
| 81 | University of Kansas.....                             | Lawrence, Kan.....              | E. Miller.....                 | Professor of mathematics.                       |
| 82 | Ottawa University.....                                | Ottawa, Kan.....                | M. L. Ward.....                | Professor of mathematics and political science. |
| 83 | Bethany College and Normal Institute.                 | Lindsborg, Kan.....             | W. A. Granville..              | Professor of mathematics.                       |
| 84 | Washburn College.....                                 | Topeka, Kan.....                | P. McVicar.....                | President.                                      |
| 85 | Kansas State Agricultural College.                    | Manhattan, Kan....              | D. E. Lantz.....               | Professor of mathematics.                       |
| 86 | West Kentucky Classical and Normal College.           | South Carrollton, Ky.           | W. C. Gaynor.....              | President.                                      |
| 87 | Millersburg Female College.                           | Millersburg, Ky....             | C. Pope.....                   | Do.                                             |
| 88 | Berea College.....                                    | Berea, Ky.....                  | P. D. Dodge.....               | Acting professor of mathematics.                |
| 89 | Emisence College and Normal School.                   | Emisence, Ky.....               | H. Boring.....                 | Teacher of mathematics, Latin, and Greek.       |
| 90 | Ogden College.....                                    | Bowling Green, Ky.              | W. A. Ohmelsain..              | President.                                      |
| 91 | Kentucky Classical and Business College.              | North Middletown, Ky.           | S. W. Percy.....               | Do.                                             |
| 92 | Hamilton Female College.                              | Lexington, Ky.....              | J. W. Porter.....              | Professor of mathematics and Latin.             |
| 93 | Keechie Male and Female College.                      | Keechie, La.....                | G. W. Thigpen...               | Professor of mathematics.                       |
| 94 | Mount St. Mary's College.                             | Emmitsburg, Md....              | J. A. Mitchell....             | Professor.                                      |
| 95 | Western Maryland College.                             | Westminster, Md....             | W. R. McDaniel..               | Professor of mathematics.                       |
| 96 | Baltimore City College...                             | Baltimore, Md.....              | W. Elliott.....                | Principal.                                      |
| 97 | Johns Hopkins University                              | do.....                         | S. Newcomb.....                | Professor of mathematics and astronomy.         |
| 98 | U. S. Naval Academy.....                              | Annapolis, Md.....              | W. W. Hendrickson, J. M. Rice. | Professors of mathematics.                      |
| 99 | Maryland Agricultural College.                        | Agricultural College P. O., Md. | H. E. Alvord.....              | President.                                      |
| 70 | St. John's College.....                               | Annapolis, Md.....              | J. W. Cain.....                | Professor of mathematics.                       |
| 71 | Maine State College of Agriculture and Mechanic Arts. | Orono, Me.....                  | J. N. Hart.....                | Instructor in mathematics.                      |
| 72 | Colby University.....                                 | Waterville, Me.....             | L. E. Warren.....              | Professor of mathematics.                       |
| 73 | East Maine Conference Seminary.                       | Bucksport, Me.....              | A. F. Chase.....               | Principal.                                      |
| 74 | Bowdoin College.....                                  | Brunswick, Me....               | W. A. Moody.....               | Professor of mathematics.                       |
| 75 | Bates College.....                                    | Lewiston, Me.....               | J. M. Rand.....                | Do.                                             |
| 76 | Agricultural College.....                             | Amherst, Mass.....              | C. D. Warner.....              | Professor of mathematics and physics.           |
| 77 | Wesleyan Academy.....                                 | Wilbraham Mass....              | B. S. Ansis.....               | Instructor in mathematics.                      |
| 78 | The Society for the Collegiate Instruction of Women.  | Cambridge, Mass....             | A. Gilman.....                 | Secretary.                                      |
| 79 | Smith College.....                                    | Northampton Mass.               | E. P. Cushing....              | Teacher of mathematics.                         |
| 80 | Leeds Seminary.....                                   | Auburnville, Mass.              | L. M. Packard....              | Instructor in mathematics.                      |
| 81 | Swain Free School.....                                | New Bedford, Mass.              | A. Ingraham.....               | Master.                                         |
| 82 | Traver Academy.....                                   | Braintree, Mass....             | C. A. Pitkin.....              | Master of mathematics and physics.              |



(a) UNIVERSITIES AND COLLEGES—Continued.

|     | Name of institution.                                    | Location.               | Name of person reporting. | Title or position of person reporting.  |
|-----|---------------------------------------------------------|-------------------------|---------------------------|-----------------------------------------|
| 83  | Amherst College.....                                    | Amherst, Mass.....      | W. C. Ealy.....           | Professor of mathematics.               |
| 84  | Massachusetts Institute of Technology.                  | Boston, Mass.....       | J. D. Runkle.....         | Professor of mathematics.               |
| 85  | Williston Seminary.....                                 | Easthampton, Mass.      | W. C. Boyden.....         | Instructor in mathematics.              |
| 86  | Williams College.....                                   | Williamstown, Mass.     | T. H. Safford.....        | Professor of astronomy.                 |
| 87  | Polytechnic Institute.....                              | Worcester, Mass.....    | J. E. Sinclair.....       | Professor of higher mathematics.        |
| 88  | Mount Holyoke Female Seminary.                          | South Hadley, Mass.     | E. W. Bardwell...         | Director of observatory.                |
| 89  | Michigan Mining School..                                | Houghton, Mich....      | R. M. Edwards...          | Professor of mining and engineering.    |
| 90  | Battle Creek College.....                               | Battle Creek, Mich..    | J. H. Haughey.....        | Mathematical department.                |
| 91  | Adrian College.....                                     | Adrian, Mich.....       | G. B. McElroy.....        | Chairman of the faculty.                |
| 92  | Hilldale College.....                                   | Hilldale, Mich.....     | A. E. Haynes.....         | Professor of mathematics.               |
| 93  | Minnesota State University.                             | Minneapolis, Minn..     | J. F. Downey.....         | Professor of mathematics and astronomy. |
| 94  | Hamline University of Minnesota.                        | Hamline, Minn.....      | E. F. Mearkle.....        | Professor of mathematics.               |
| 95  | Washington University..                                 | St. Louis, Mo.....      | C. M. Woodward..          | Do.                                     |
| 96  | Kansas City Ladies' College.                            | Independence, Mo..      | J. M. Chaney.....         | President.                              |
| 97  | Missouri State University.                              | Columbia, Mo.....       | W. B. Smith.....          | Professor of mathematics and astronomy. |
| 98  | School of Mines, University of Missouri.                | Rolla, Mo.....          | W. H. Echols.....         | Professor of applied mathematics.       |
| 99  | College of the Christian Brothers.                      | St. Louis, Mo.....      | Brother Paulian..         | President.                              |
| 100 | William Jewell College...                               | Liberty, Mo.....        | J. E. Clark.....          | Professor of mathematics.               |
| 101 | Drury College.....                                      | Springfield, Mo.....    | A. F. Amadon.....         | Professor of mathematics and physics.   |
| 102 | Cooper Normal College...                                | Daleville, Miss.....    | T. F. McBeath.....        | President.                              |
| 103 | Agricultural and Mechanical College.                    | Starkville, Miss.....   | H. C. Davis.....          | Acting professor of mathematics.        |
| 104 | University of Mississippi.                              | University P. O., Miss. | C. M. Sears.....          | Professor of mathematics.               |
| 105 | Deane College.....                                      | Crete, Nebr.....        | A. B. Shew.....           | Librarian.                              |
| 106 | University of Nebraska...                               | Lincoln, Nebr.....      | H. E. Hitchcock..         | Professor of mathematics.               |
| 107 | New Hampshire College of Agriculture and Mechanic Arts. | Hanover, N. H.....      | C. H. Pettes.....         | Do.                                     |
| 108 | Wake Forest College.....                                | Wake Forest, N. C..     | L. E. Mills.....          | Professor of pure mathematics.          |
| 109 | University of North Carolina.                           | Chapel Hill, N. C..     | J. L. Love.....           | Associate professor of mathematics.     |
| 110 | Trinity College.....                                    | Randolph County, N. C.  | J. M. Bandy.....          | Professor of mathematics.               |
| 111 | Rutherford College.....                                 | Burke County, N. C.     | R. L. Abernethy..         | President.                              |
| 112 | College of the Sacred Heart.                            | Vineland, N. J.....     | P. O'Connor.....          | Professor of mathematics.               |
| 113 | Niagara University.....                                 | Niagara, N. Y.....      | E. A. Antill.....         | Do.                                     |
| 114 | Union College.....                                      | Schenectady, N. Y..     | B. H. Ripton.....         | Do.                                     |
| 115 | Columbia College.....                                   | New York, N. Y.....     | W. G. Peck.....           | Do.                                     |
|     |                                                         |                         | T. S. Fiske.....          | Tutor in mathematics.                   |

## (a) UNIVERSITIES AND COLLEGES—Continued.

|     | Name of institution.                               | Location.                 | Name of person reporting.             | Title or position of person reporting.                      |
|-----|----------------------------------------------------|---------------------------|---------------------------------------|-------------------------------------------------------------|
| 116 | University of Rochester ..                         | Rochester, N. Y. ....     | G. D. Olds .....                      | Professor of mathematics.                                   |
| 117 | St. Lawrence University ..                         | Canton, N. Y. ....        | H. Priest .....                       | Professor of mathematics and physics.                       |
| 118 | The College of the City of New York.               | New York, N. Y. ....      | A. S. Webb .....                      | President.                                                  |
| 119 | Syracuse University .....                          | Syracuse, N. Y. ....      | J. E. French .....                    | Professor of mathematics.                                   |
| 120 | U. S. Military Academy ..                          | West Point, N. Y. ....    | E. W. Bass .....                      | Do.                                                         |
| 121 | Packer Collegiate Institute.                       | Brooklyn, N. Y. ....      | W. L. C. Stevens ..                   | Professor of mathematics and physics.                       |
| 122 | Brooklyn Collegiate and Polytechnic Institute.     | do. ....                  | R. Sheldon .....                      | Professor of pure mathematics.                              |
| 123 | Ohio University .....                              | Athens, Ohio .....        | William Hoover ..                     | Professor of mathematics.                                   |
| 124 | Ohio State University .....                        | Columbus, Ohio .....      | R. D. Behannan ..                     | Professor of mathematics and astronomy.                     |
| 125 | Miami University .....                             | Oxford, Ohio .....        | J. V. Collins .....                   | Do.                                                         |
| 126 | Case School of Applied Science.                    | Cleveland, Ohio .....     | C. Staley .....                       | President.                                                  |
| 127 | Hiram College .....                                | Hiram, Ohio .....         | C. Bancroft .....                     | Professor of mathematics and astronomy.                     |
| 128 | Oberlin College .....                              | Oberlin, Ohio .....       | H. C. King .....                      | Associate professor of mathematics.                         |
| 129 | Denison University .....                           | Granville, Ohio .....     | J. L. Gilpatrick ..                   | Professor of mathematics.                                   |
| 130 | Marietta College .....                             | Marietta, Ohio .....      | O. H. Mitchell .....                  | Professor of mathematics and astronomy.                     |
| 131 | Buchtel College .....                              | Akron, Ohio .....         | C. S. Howe .....                      | Do.                                                         |
| 132 | University of Cincinnati ..                        | Cincinnati, Ohio .....    | H. T. Eddy .....                      | Professor of mathematics, civil engineering, and astronomy. |
| 133 | Pacific University .....                           | Forest Grove, Oregon ..   | W. N. Ferrill .....                   | Professor of mathematics.                                   |
| 134 | The State Agricultural College of Oregon.          | Corvallis, Oregon .....   | J. D. Letcher .....                   | Professor of mathematics and engineering.                   |
| 135 | Dickinson College .....                            | Carlisle, Pa. ....        | F. Durell .....                       | Professor of mathematics.                                   |
| 136 | Bryn Mawr College .....                            | Bryn Mawr, Pa. ....       | Charlotte A. Scott ..                 | Associate professor of mathematics.                         |
| 137 | Pardee Scientific Department of Lafayette College. | Easton, Pa. ....          | J. G. Fox .....                       | Professor of civil and topographical engineering.           |
| 138 | Lehigh University .....                            | South Bethlehem, Pa. .... | C. L. Doolittle .....                 | Professor of mathematics.                                   |
| 139 | Swarthmore College .....                           | Swarthmore, Pa. ....      | S. J. Cunningham ..                   | Do.                                                         |
| 140 | Haverford College .....                            | Haverford, Pa. ....       | Isaac Sharpless<br>Frank Morley ..... | Professor of mathematics.<br>Instructor in mathematics.     |
| 141 | Mohr College .....                                 | Allentown, Pa. ....       | D. Garber .....                       | Professor of astronomy.                                     |
| 142 | Central Pennsylvania College.                      | New Berlin, Pa. ....      | H. R. Kelly .....                     | Professor of mathematics.                                   |
| 143 | Brown University .....                             | Providence, R. I. ....    | N. F. Davis .....                     | Assistant professor of mathematics.                         |
| 144 | Furman University .....                            | Greenville, S. C. ....    | C. H. Judson .....                    | Professor of mathematics and mechanical philosophy.         |
| 145 | University of South Carolina.                      | Columbia, S. C. ....      | E. W. Davis .....                     | Professor of mathematics and astronomy.                     |
| 146 | Columbia Female College ..                         | do. ....                  | J. G. Clinkscale ..                   | Professor of mathematics.                                   |

(a) UNIVERSITIES AND COLLEGES—Continued.

|     | Name of institution.                          | Location.                 | Name of person reporting. | Title or position of person reporting.                  |
|-----|-----------------------------------------------|---------------------------|---------------------------|---------------------------------------------------------|
| 147 | Flak University .....                         | Nashville, Tenn. ....     | H. H. Wright.....         | Professor of mathematics and instructor in vocal music. |
| 148 | University of Tennessee..                     | Knoxville, Tenn. ....     | Wm. W. Carson...          | Professor of mathematics and civil engineering.         |
| 149 | Grant Memorial University.                    | Athens, Tenn. ....        | D. A. Bolton .....        | Professor of mathematics.                               |
| 150 | Bethel College.....                           | McKenzie, Tenn. ....      | W. W. Hamilton..          | Do.                                                     |
| 151 | Chattanooga University ..                     | Chattanooga, Tenn. ....   | E. A. Robertson...        | Do.                                                     |
| 152 | Vanderbilt University ..                      | Nashville, Tenn. ....     | Wm. J. Vaughn...          | Do.                                                     |
| 153 | University of Texas .....                     | Austin, Tex. ....         | G. B. Halsted.....        | Professor of pure and applied mathematics.              |
| 154 | Agricultural and Mechanical College of Texas. | College Station, Tex.     | L. L. M'Innis .....       | Professor of mathematics.                               |
| 155 | Randolph-Macon College..                      | Ashland, Va. ....         | R. B. Smitley.....        | Do.                                                     |
| 156 | Emory and Henry College..                     | Emory, Va. ....           | S. M. Barton .....        | Do.                                                     |
| 157 | Hampden-Sidney College..                      | Hampden-Sidney, Va.       | J. R. Thornton...         | Do.                                                     |
| 158 | University of Virginia....                    | Charlottesville, Va..     | C. S. Venable .....       | Do.                                                     |
| 159 | Bethel Military Academy.                      | Bethel Academy P. O., Va. | E. S. Smith.....          | Instructor in higher mathematics and modern languages.  |
| 160 | Virginia Agricultural and Mechanical College. | Blacksburg, Va. ....      | J. E. Christian .....     | Professor of mathematics and civil engineering.         |
| 161 | Polytechnic Institute.....                    | New Market, Va. ....      | W. H. Smith .....         | President.                                              |
| 162 | Vermont Methodist Seminary.                   | Montpelier, Vt. ....      | E. A. Bishop .....        | Principal.                                              |
| 163 | Norwich University .....                      | Northfield, Vt. ....      | J. B. Johnson .....       | Professor of mathematics.                               |
| 164 | University of Washington.                     | Seattle, Wash. ....       | J. M. Taylor .....        | Do.                                                     |
| 165 | Wheeling Female College..                     | Wheeling, W. Va. ....     | H. R. Blaisdell .....     | President.                                              |
| 166 | West Virginia College....                     | Flemington, W. Va. .      | T. E. Feden .....         | Do.                                                     |
| 167 | Ripon College .....                           | Ripon, Wis. ....          | C. H. Chandler.....       | Professor of mathematics and physics.                   |
| 168 | Beloit College .....                          | Beloit, Wis. ....         | T. A. Smith.....          | Do.                                                     |

*Are students entering your institution thorough in the mathematics required for admission?*

"No," "not generally," "by no means," "seldom:" 3, 5, 6, 7, 8, 9, 12, 13, 14, 16, 17, 19, 20, 21, 22, 23, 25, 27 (but growing better), 29, 31, 33, 36, 39, 40, 42, 43, 44, 47, 49, 51, 52, 53, 56, 57, 58, 59, 60, 61, 63, 66, 67, 68, 69, 70, 72, 73, 76, 80, 82, 83, 86, 88, 91, 92, 93 (but marked improvement every year), 94, 96, 97, 99, 102, 104, 105, 109, 110, 111, 113, 117, 160, 161, 162, 163, 164, 165, 166, 167, 168 (and this is one of the evils of our times).

"Fairly so," "reasonably so:" 10, 11, 15, 30, 32, 34, 37, 46, 55, 84, 95.

"Not as thorough as we desire:" 35, 38, 41, 71, 74, 87, 107, 108, 114, 116.

"Yes:" 1 (most of them), 28, 45 (generally), 54 (or fail to enter), 64, 65 (usually), 78 (a fair proportion), 79 (generally), 89, 90 (or fail to enter), 100 (or they are placed in preparatory department), 101, 112 (generally), 115.

*Is the mathematical teaching by text-book or by lecture?*

This question was answered by all who sent in reports. The following forty six answers were "by text-book," without indicating that any lectures whatever were given: 6, 7, 11, 12, 14, 17, 18, 20, 21, 24, 25, 26, 29, 30 (it is impossible to teach mathematics by lecture), 32, 33, 37, 44, 50, 51, 53, 63, 65, 64, 73, 74, 85, 88, 101, 102, 105, 107, 109, 113, 114, 125, 138, 141, 142, 147, 149, 150, 151, 161, 163, 164.

The following sixty-five answers were "mainly by text-book," "text-book principally," "text-book as a basis," "text-book and informal lectures," or some similar phrase, indicating that the text-book predominated: 1, 3, 8, 9, 15, 19, 22, 24, 31, 34, 35, 40, 41, 43, 45, 47, 48, 52, 53, 57, 59, 59, 60, 62, 66, 71, 72, 75, 77, 80, 86, 87, 89, 90, 91, 92, 93, 95, 97, 100, 103, 106, 110, 116, 118, 119, 120, 122, 123, 128, 133, 134, 135, 136, 137, 143, 144, 145, 155, 156, 159, 162, 166, 167, 168.

The following fifty-five answered "by both," or "by text-book and lecture," without saying which predominated: 2, 4, 5, 10, 16, 23, 27, 35, 38, 39, 42, 46, 49, 54, 56, 61, 64, 67, 69, 70, 76, 78, 79, 82, 83, 84, 94, 96, 98, 99, 104, 108, 111, 112, 115, 117, 121, 124, 126, 127, 129, 130, 131, 132, 139, 140, 143, 146, 152, 153, 154, 157, 158, 160, 165. The answer of number 13 is "by lectures, except elementary geometry;" and of 81, "by lecture."

*What mathematical journals are taken?*

The following answered "none:" 1, 3, 5, 6, 7, 9, 14, 15, 17, 20, 21, 22, 24, 25, 29, 30, 32, 33, 36, 39, 40, 43, 44, 45, 48, 49, 50, 53, 56, 57, 58, 59, 60, 63, 65, 69, 70, 71, 73, 74, 76, 77, 78, 79, 80, 81, 82, 85, 87, 88, 89, 91, 94, 96, 99, 101, 102, 103, 104, 105, 107, 108, 112, 114, 116, 117, 121, 122, 128, 129, 133, 134, 141, 147, 149, 150, 151, 159, 160, 162, 163, 168, 167, 168. Some of these answers were "none by the college," "none that are purely mathematical," "several scientific and engineering journals," but most of them were simply "none." In addition to this list, numbering eighty-four, we may safely add thirty-three that did not answer this question in their report, making one hundred and seventeen institutions out of one hundred and sixty-eight that take no mathematical journal of any sort devoted to pure mathematics.

The following reported as taking simply the *American Journal of Mathematics*: 10, 27, 28, 54, 55, 72, 75, 84, 95, 131, 145.

The following, as taking simply the *Annals of Mathematics*: 4, 8, 13, 16, 23, 42, 64, 90, 100, 110, 148, 157.

University numbered 11 is taking *d, k, l*, marked below;\* 12, *b, d, u*; 19, *k*; 35, *b, d, t, e*; 37, *k*; 38, *b, d, q, u*; 41, *d, m, l*; 46, *b, k*, etc.; 47, *b, d*; 51, *b*, nearly all the foreign journals are expected after this year; 67, all the leading ones; 68, nearly all mathematical journals; 83, *b, d, j*; 86, *b, k, u*; 92, *k, l, o*, etc.; 93, *b, d*; 97, *b, j*, etc.; 98, *b, d, u*; 106, *a, b, Jahrbuch d. Vortsch. d. Math.*; 109, *d, j, p*; 111, any we can get; 115, *a, b, c, d, e, f, g, h, i, j, m, n, p, s, t, u*; 152, *b, d, j, m, p, s, t*; 153, *b, d, t*; 154, *d, s*; 155, *d, p*; 158, *d, p*, and others; 161, *q*; 164, *d, k, l*.

*Are there any mathematical seminaries or clubs, and how are they conducted?*

All answered in the negative, except the following:

15. No clubs, unless special classes for voluntary and outside reading be so designated. Such classes are conducted like all other classes.

38. A club. The meetings of the club occur on alternate Tuesdays. Membership about 25; topics are assigned to or chosen by the student at his option; assistance is given him as he may need. The work is pedagogical, rather than original.

41. One. Reading and exposition of the more difficult parts of Williamson's *Calculus*.

51. In connection with the Science Club; by lectures.

67. There is a mathematical society, in which there is free choice of subjects for communication, and there are two or three seminaries for post-graduate students, conducted by the teacher on special lines.

\*1. *Acta Mathematica*. 2. *American Journal of Mathematics*. 3. *Annali di Matematica*. 4. *Annals of Mathematics*. 5. *Archiv d. Math. u. Physik*. 6. *Bulletin des Sciences Math. et Astron.* 7. *Bulletin de Societe Math.* 8. *Comptes Rendus*. 9. *Journal de Math. (Lyonville)*. 10. *Journal f. reine u. angew. Math. (Crelle)*. 11. *Mathematical Magazine*. 12. *Mathematical Visitor*. 13. *Mathematische Annalen*. 14. *Messenger of Mathematics*. 15. *Proceedings London Math. Society*. 16. *Nouvelles Annales de Math.* 17. *School Visitor*. 18. *School Messenger*. 19. *Quarterly Journal of Math.* 20. *Zeitschrift f. Math. u. Phys.* 21. *Zeitschrift f. Vermessungskunde*.

*Are there any mathematical seminars or clubs, and how are they conducted?*—Continued.

115. Yes, one. It proposes to discuss the literature of mathematics, to solve problems given by members, and to make original investigations.

136. No clubs, but seminars, through part of regular course, but not very formal; they are intended to afford students opportunity of working problems under guidance.

143. There are men in each class studying for honors. The principal part of their work is the solution of original problems. I meet them frequently for discussions and suggestions.

158. No clubs; the lectures and recitations regularly extend through an hour and a half, and at each original solutions of problems are given, and next time are called for. Each meeting of each class is a seminarium.

*Are there any scholarships or fellowships for graduate students in mathematics?*

All who answered this said "no," except the following:

67. Yes.

84. None for mathematics exclusively.

86. One is occasionally given to a man of high promise.

93. Fellows are allowed to choose mathematics.

97. One fellowship; two scholarships await instantly State appropriation for support.

115. Yes, an annual fellowship in science.

136. One fellowship awarded yearly to a properly qualified graduate of any college.

145. Yes, there is one, retainable for two years.

159. Occasionally conferred on deserving students wishing to prosecute their studies at other institutions.

*Is the percentage of students electing higher mathematics increasing or decreasing?*

The following reported "increasing:" 1, 5, 6, 8, 9, 12, 15 (among scientific students), 16, 21, 24, 25, 26, 27, 28, 31, 32, 33 (?), 35, 37, 38, 39, 40, 42 (?), 46, 50, 51, 53, 54, 55, 56 (with gentlemen), 57, 59, 63, 73, 75, 76, 78, 79, 82, 83, 90, 93, 97, 98, 99, 101, 102, 108, 108, 111, 112, 113, 116, 117 (?), 119, 123, 124, 125, 126, 128, 129, 132, 137, 140, 142, 144, 145, 149, 150, 151, 153, 154, 156, 157, 158, 159, 160, 161, 164, 165, 166.

The following reported "about constant," "neither increasing nor decreasing:" 3, 4, 23, 30, 48, 67, 70, 74, 80, 84, 86, 91, 92, 100, 104, 107, 114, 115, 118, 122, 127, 130, 131, 141, 147, 148, 162, 163.

The following reports indicated a "decrease:" 15 (among classic students), 44, 49, 56 (with ladies), 83.

The following reported that none of the mathematical studies were elective: 10, 11, 17, 18, 20, 22, 36, 41, 45, 47, 52, 65, 71, 65, 87, 94, 96, 103, 105, 108, 120, 133, 135, 139, 142, 146, 155.

*Does the interest in mathematics increase as students advance to higher subjects?*

"Yes:" 3, 5, 6, 8, 10, 11, 13, 16, 17, 18, 21, 22, 23, 26, 28, 29, 30, 32, 35, 36, 37, 38, 40, 41, 42, 46, 48, 50, 51, 52, 53 (very much), 54 (generally), 55, 57, 59, 60, 61, 63, 65, 66 (?), 73, 77, 79, 82, 84, 87 (generally), 89, 90, 92, 93, 94, 95, 98, 101, 102, 104 (?), 105 (?), 108, 111, 112, 113, 116, 118, 119, 122, 123, 126, 131, 132, 133, 134, 139, 140, 145 (generally), 146, 147, 150, 151, 153, 154, 156, 157, 158 (emphatically so), 159, 160, 161, 163, 164, 165, 166, 167.

"With the best students only," "with those students whose mental tendencies are along mathematical lines," or some similar remark: 1, 4, 9, 12, 24, 25, 31, 33, 34, 43, 44, 45, 47, 56, 58, 62, 70, 71, 72, 74, 75, 76, 80, 81, 85, 107, 114, 120, 121, 124, 125, 127, 128, 129, 130, 136, 137, 141, 142, 143, 148, 149, 152, 155.

"The interest increases so long as the student sees the bearing of his work upon practical scientific investigation or can be assured that it has such a bearing." "It increases as application to practical matters is shown:" 15, 19, 69, 103.

"All who understand the principles show a growing interest," "where proper preparation on the part of the student has been attended to and the teacher is a live man, it does" (110), "The interest is according to the clearness of apprehension of mathematical truths. Hence, the more evolved or abstruse the matter, the greater the interest to those who succeed" (144): 27, 91, 97, 110, 115, 144.

"No:" 2, 7, 20, 34 (for poor students), 39, 43 (for the majority), 49, 66, 100, 106, 109, 135, 162, 168.

*Are prizes awarded for excellence of daily class-room work, or for success in original research?*

"No prizes awarded:" 1, 4, 6, 7, 8, 10, 13, 14, 16, 17, 19, 20, 21, 23, 26, 29, 30, 31, 32, 33, 34, 35, 37, 38, 39, 40, 41, 43, 46, 47, 48, 49, 50, 51, 52, 53, 55, 56, 58, 59, 60, 61, 63, 64, 65, 66, 69, 70, 71, 72, 73, 76, 78, 79, 80, 81, 84, 85, 87, 88, 89, 90, 91, 93, 94, 95, 98, 100, 101, 103, 104, 105, 106, 107, 108, 111, 112, 114, 115 (except class honors), 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 131, 132, 133, 135, 136, 138, 139, 140, 141, 142, 144, 145, 147, 148, 149, 150, 151, 152, 154, 156, 157, 158, 160, 161, 164, 166, 167, 168.

"For both:" 2, 9, 36, 67 (bestowal of scholarships and fellowships is based upon both the considerations), 82, 99, 134, 155 (but I do not believe in prizes).

"For work in the class-room:" 18, 22, 25, 26, 62, 66, 77, 86, 96, 118, 137, 143, 159, 162.

"For outside work, not generally original:" 15, 116.

"For original investigation only:" 97, 102, 117.

"Yes, prizes are awarded:" 3, 5, 11, 12, 24, 27, 54, 57, 74 (scholarship of \$300 to best Sophomore in mathematics), 92, 97, 109, 110, 113, 165.

*What mathematical subjects are preferred by students?*

The answers given point to no definite conclusion. For want of space, they are here omitted, except the following: "Their preferences are generally for the particular subject which they have had the best elementary training in" (148).

*Are topics assigned to students for special investigation?*

1. Yes.
2. Problems are proposed.
3. Sometimes prize problems are given to students.
5. Yes.
6. Yes.
7. For the higher classes.
8. Yes; often.
9. Yes.
10. Not in general.
11. To a small extent.
12. Occasionally.
14. No.
17. Yes.
18. Sometimes.
19. Occasionally.
20. No.
21. Yes.
22. No.
23. Yes.
24. Yes.
25. No.
26. There are.
27. Independent problems given in all the classes for solution, reported on paper.
28. Once each term.
29. No.

*Are topics assigned to students for special investigation?—Continued.*

30. Not much. The man who pursues original investigation with the average student will make a failure.
31. We have not been accustomed to do so.
32. Not to any extent that deserves mention.
33. Practically, no.
34. Not to under-graduates. There are no graduate students in mathematics at present.
35. Yes.
36. Yes; but necessarily elementary.
37. Yes, sir.
38. Yes, in connection with the club and for graduation theses.
39. Yes.
40. Sometimes; but our classes are generally so closely occupied by their various studies, there is but little time for extra work.
41. No.
42. Yes.
43. Yes.
44. Frequently.
45. They are, and form a very essential part of the work.
46. Students in the higher classes are assigned such topics.
47. None advanced enough.
48. Yes.
49. Sometimes.
51. Yes.
52. Occasionally.
53. Yes.
54. Yes.
55. No.
56. Yes.
58. Yes.
59. Yes; with good success.
60. Yes.
63. Yes.
64. No.
65. No.
67. They are in the seminaries.
68. No.
69. A few.
70. To a limited extent.
71. No.
72. Not to any great extent.
73. Occasionally.
74. In elective divisions.
76. To some extent.
77. Rarely.
78. Yes.
79. No.
81. Yes.
82. Yes.
84. No.
85. No.
86. Yes, to post-graduates.
87. Yes.
88. Not often.

*Are topics assigned to students for special investigation?—Continued.*

89. In applied mechanics, yes.
90. Not for original investigation, but otherwise.
91. Occasionally.
92. Yes, for thesis in general geometry and calculus.
93. Yes, especially in elementary geometry, analytical geometry, and calculus.
94. Yes.
95. Rare.
96. Only to a limited extent.
97. Such assignment has hitherto been only exceptional, hereafter to be made regular.
98. In applied mathematics theses are required on special subjects, and original investigation encouraged.
99. Yes.
100. No.
101. Yes.
102. Yes, in all the different branches, especially in applied mathematics.
103. The graduating and other theses are on subjects divided among the departments.
104. No.
105. No.
106. They are.
107. Yes.
108. Yes.
109. No.
110. Yes, this is encouraged in all the classes, but is secured best in the higher classes.
111. Yes.
112. Occasionally original theorems and problems are given.
114. Occasionally, results submitted in original theses.
115. No, except the work done in the seminary.
116. Yes, in all classes of all departments.
117. No.
118. Yes, to a large extent in geometry.
119. In pure mathematics very seldom; not in applied mathematics.
120. Yes.
121. No.
122. No.
123. No.
124. We have this in view for next term.
125. None as yet.
126. Yes.
127. Yes.
128. Yes.
129. To some extent.
130. Yes.
131. Occasionally.
132. No.
133. To some extent.
134. Occasionally.
135. No.
136. I should consider this exercise profitable only to very advanced students; and have not had occasion to employ it yet.
137. Yes, to some extent.
138. No.



*Are topics assigned to students for special investigation?—Continued*

139. No.
140. Occasionally.
141. Not to any extent.
142. Yes, in applied geometry, surveying, and physics.
143. Occasionally to advanced students.
144. Only exercises in theorems and problems.
145. Yes.
146. Yes.
147. No.
148. The solution of problems related to the recitations is required. Nothing else.
149. No.
150. No.
152. No.
153. Yes.
154. Yes.
155. In the higher classes topics are occasionally assigned.
156. No.
157. Original exercises are given at intervals.
158. To graduate students, candidates for the degree of Ph. D.
159. But few outside of text-book.
160. Yes.
161. No.
162. No.
163. No.
164. Yes.
165. Yes.
166. Yes.
167. To some extent.
168. Occasionally.\*

(a) *Is any attention given to the history of mathematics?* (b) *Does it make the subject more interesting?*

(a) "Yes:" 1, 5, 9, 13, 34, 35, 37, 39, 42, 44, 46, 48, 52, 53, 61, 63, 64, 65, 72, 80, 81, 90, 92, 97, 98, 99, 101, 102, 103, 112, 114, 116, 123, 126, 129, 131, 135, 136, 138, 145, 152, 153 (great), 154, 156, 157, 158, 160, 164.

(a) "Very little," "only incidentally," "not much", etc.: 4, 6, 8, 11, 12, 13, 16, 17, 19, 21, 23, 24, 25, 27, 28, 30, 34, 40, 41, 43, 45, 47, 51, 54, 55, 56, 58, 59, 60, 66, 67, 68, 73, 74, 75, 76, 78, 79, 82, 86, 88, 91, 93, 94, 100, 104, 106, 107, 111, 115, 118, 119, 120, 121, 124, 125, 127, 128, 130, 133, 137, 143, 144, 147, 151, 159, 163, 168.

(a) "No:" 3, 7, 10, 14, 20, 22, 29, 32, 33, 36, 40, 50, 57, 69, 70, 71, 77, 83, 85, 87, 89, 95, 96, 103, 105, 109, 110, 117, 122, 132, 134, 139, 140, 142, 146, 148, 149, 150, 161, 162, 166, 167.

(b) "Yes," "it does," "most decidedly," was the experience of all who had given any attention, in the class-room, to mathematical history, except the following, who were in doubt: 11, 15, 16, 47, 56, 76, 104, 120. Even these were inclined to say "yes." No one answered that it did not make the subject more interesting—a clear case.

*How does analytical mathematics compare in disciplinary value with synthetical?*

1. I regard both methods equally important.
4. I think synthetical has much the greater disciplinary value; analytical has much the greater value for practical application. Analysis is the principal tool for investigation and work.

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\* Widely different views seem to be implied in the above answers as to what constitutes a "topic for special investigation."

*How does analytical mathematics compare in disciplinary value with synthetical?—Cont'd.*

5. Analytical superior.
6. The former used more largely in the Grammar Department.
8. Analytical mathematics gives the better mental discipline.
9. I think both necessary to full mental development, but if I were obliged to choose I should prefer analytical.
10. I can not say fairly, for my teaching has been wholly in analytical mathematics. In my studies I prefer that method.
11. I use combination of both and so can not well answer.
12. The development of reason is more regular, rapid, and substantial in geometry than in any other branch of the mathematical course. For advanced students I would count algebraic analysis a superior discipline.
13. It seems to be a question of individuality.
15. I regard analytical mathematics as the more valuable and the more important.
16. The former is superior.
17. It is superior.
18. Analytical seems to be better.
19. Common geometry, considered as an application of logic, especially in the demonstration of easy "riders" and in very simple exercises in constructions, is of pre-eminent value to quite young and undisciplined minds. At different stages each has its peculiar and really unmeasurable value.
20. They are of equal value.
21. I have not data enough for an opinion.
22. Superior, if the two are divorced; but the synthetical should be united with it.
23. Favorably.
24. Analytical greater.
25. With the majority of students more satisfactory results are obtained through the synthetical method of reasoning.
26. Analytical preferred.
27. As a rule, I have found that students stand better in geometry than in algebra. When analytical geometry is clearly comprehended, it affords the best discipline for the mind.
28. Synthesis seems to give better discipline.
30. Analytical preferable.
31. The former is a better test for form and figure, the latter seems to tax the memory.
32. We have no classes sufficiently advanced to test the relative value extensively.
33. If the work be the same in both, the synthetical.
34. My own preference is analytical.
35. Could not get along with either method left out (Professor Shattuck). Each has its special function; as well ask whether braces or tie-rods are of most service in a bridge-truss (Regent Peabody).
36. Synthetical more valuable.
37. Disciplinary value of former is greater.
38. We give the analytical the first consideration after the student is led up to it.
40. Superior.
41. I think the former the more valuable as an instrument of research, the latter as a means of discipline.
42. The analytical is more valuable simply as a means of discipline.
43. The synthetical is better for younger students; the analytical for those more mature.

*How does analytical mathematics compare in disciplinary value with synthetical?—Cont'd.*

45. It is evidently far superior.
46. Each affords excellent discipline.
47. It is superior.
48. For college grade we think the analytical produces the best results.
49. Better.
50. Better for discipline, but we have not used it as yet.
51. Somewhat superior in value.
52. Superior.
53. Analytical training is more beneficial.
54. Favorably.
55. They are superior.
56. Prefer the analytical.
57. We use both methods, but give preference to former.
58. Can we do without either? I should say both are necessary, but analytical is less taught.
59. Analyzing the whole into its elements is valuable, but building the whole from elements is very valuable.
60. Superior for advanced students.
63. The analytical the more valuable.
65. Analytic mathematics is far superior in its disciplinary value.
67. The latter is probably the more valuable discipline in early stages of a mathematical education; but after the elements of geometry are mastered, probably the reverse is true.
68. In general we prefer analytical methods.
69. Latter preferred.
70. Doubtful; students prefer synthetical.
73. In my judgment the analytical method is to be preferred.
75. For the average student the synthetical gives better results.
76. I think analytical mathematics better for mental discipline.
79. Its disciplinary value is less than that of the synthetical.
80. The synthetical is more valuable.
81. They interact; but the latter is an indispensable prerequisite for the former.
82. I should place analytical as greater in disciplinary value.
84. Analytical is inferior to synthetical.
86. Both methods are essential and I am not aware of any difference. Perhaps I do not understand the question.
87. Superior; yet this depends, perhaps, on the mind of the individual student.
90. Very favorably, so far as our experience has gone.
91. I prefer the former for advanced students—the latter for beginners, or students of a low grade.
92. Synthetical seems best for the less advanced students.
93. I do not believe that the two can be separated and compared. I believe with Sir William Hamilton, "Analysis and synthesis are only the two necessary parts of the same method. Each is the relative and correlative of the other." Neither without the other would be of much value.
94. The synthetical is absolutely necessary as a foundation of good work; after the foundation, the former is desirable.
95. Do you mean graphical (or geometrical) by synthetical? I think descriptive geometry has the finest disciplinary value.
97. As commonly taught, unfavorably; as taught here, with special stress on Morphology and by aid of determinants, very favorably.
98. In favor of the former.

*How does analytical mathematics compare in disciplinary value with synthetical?—Cont'd.*

99. Are in favor of the analytical.

101. Superior.

102. That depends upon the peculiar natural bent of the pupil's mind. For some, analysis, and for others, synthesis is more valuable.

104. Can not institute comparison, we use both in combination.

106. I would answer this by saying, that I consider special geometry better for mental discipline than analytical geometry, and geometry better than algebra.

109. Analytical superior.

110. In my judgment the analytical is so far superior to the synthetical that there is left little room for comparison. Permit me to say that reason wants light, not darkness.

111. They are about equal. We use Peck's and Davies' methods.

112. The comparison is in favor of analytical mathematics.

113. The analytical method, in my opinion, produces better results than the synthetical.

114. Superior.

115. Each has its special value; both are desirable (Professor Peck). Analytical gives the more rigorous training. Each plays its own part (Tutor Flake).

116. Synthetical better for training in formal logic; in other respects analytical is unquestionably superior.

117. Synthetical seems to give better results.

118. For older students the analytical methods are superior; for those below the Sophomore class, this is doubtful.

119. I think the analytical is better.

120. Analytical mathematics predominates here, and therefore has the greater disciplinary value. If comparing equal times in the two, I should say synthetical.

122. Synthetic best for discipline; analytic best for use.

123. Former is better.

125. It is hard for me to answer this. Perhaps the latter is superior for dull or average students, while the former is preferable for the more able.

126. Both necessary for proper discipline.

128. Well.

129. Analytical mathematics is the better.

130. Sometimes seems to me superior; sometimes seems to me inferior, depending upon the mental character of the student.

132. We teach no synthetical mathematics in the university, except a book of elementary mechanics, which is good in its place, but analytical mathematics alone develops real mathematical power.

133. I regard the analytic method as much superior in way of developing habit and power of investigation.

134. I use both and would not willingly part with either. Deem them of about equal value.

135. Equally valuable though in different way.

136. I should be inclined to give preference to analytical; but where there is a strong natural mathematical bent, possibly more discipline is derived from synthetical mathematics.

137. Rather unfavorably with the average student.

139. Superior.

140. Better.

143. Both valuable; both necessary.

144. Analytical is favorable for advanced students; synthetical, for younger students.

*How does analytical mathematics compare in disciplinary value with synthetical?—Cont'd.*

145. The value of the discipline depends upon the closeness of the student's application rather than upon the methods employed.

146. Superior to it.

147. I consider the analytical far superior to the synthetical.\*

148. In my opinion, the analytical is far superior to the synthetical.

149. I think the analytic is better.

150. The former is of more disciplinary value than the latter.

151. The analytical mathematics in most cases most satisfactorily fulfils the end or object of mathematical study.

152. The former, in my opinion, is preferable in almost every respect.

153. Analytical mathematics is very far inferior to synthetic in disciplinary value.

155. Analytical mathematics has, I think, a higher disciplinary value than synthetical.

156. The synthetical is more valuable, I think, but by no means should either be adopted to the exclusion of the other.

158. Impossible to make a comparison in so short space.

159. I regard analytical mathematics as possessing higher disciplinary value, when properly taught.

160. Analytical mathematics is superior to synthetical in disciplinary value.

161. Favorably, both should be used.

163. I favor analytical mathematics.

164. Analysis is superior in disciplinary value.

165. Superior.

166. They are about equal.

167. Any true method of study seems to me to use them both, with so frequent changes that comparison is difficult. Moreover, their relative value differs with different pupils.\*

5) *What method of treating the calculus do you favor, that of limits, the infinitesimal, or some other? (b) Does the infinitesimal seem rigorous, and to satisfy the mind of the student?*

1. (a) Limits. (b) Does not satisfy the student.

3. Calculus is not taught in this college.

4. (a) I favor the method of rates, though I use the method of limits and infinitesimals—the latter in mechanics. (b) It does not in my experience.

5. We do not teach it.

8. (a) That of limits. (b) At first it does not seem rigorous to the student, nor to satisfy his mind.

9. (a) We think, with many others, the subject needs both. (b) Not sufficiently so, and hence the advantage of calling "limits" to its aid.

10. (a) Calculus is not taught here. Personally I prefer infinitesimals. (b) I think so, more than that of limits, which is better for the mathematician than the student.

11. (a) I favor none exclusively. I teach "rates", "infinitesimals", and "limits." (b) It does not seem rigorous.

12. (a) The method of limits (now made familiar in geometry) seems most satisfactory. (b) Not to beginners. Later this method should be studied also.

13. (a) Defining  $f'(a)$  as co-efficient in development:  $f(x) = f(a) + f'(a)(x-a) + \dots$  (b) It does not seem rigorous as usually represented, but could be made so, but I doubt whether for beginners.

15. (a) I favor the method known as that of "rates." (b) I think not.

\*For collateral reading on this question see President C. W. Elliot's article, "What is a Liberal Education?" in the Century Magazine, June, 1884; Report of the (English) Commission in 1853; report of the French Commissioners in 1870.

(a) *What method of treating the calculus do you favor, that of limits, the infinitesimal, or some other?* (b) *Does the infinitesimal seem rigorous, and to satisfy the mind of the student?*—Continued.

16. (a) A combination of limits and infinitesimals. (b) Combined with the method of limits, it does; alone, no.

17. (a) Infinitesimal; a little about limits. (b) I have never yet had a student to whom I could not make it perfectly satisfactory.

18. (a) Limits. (b) No.

19. (a) In theory, Buckingham's "direct method of rates;" practically, the infinitesimal as set forth by Olney and others, on account of its practical advantages. (b) The philosophy at the base of this method seems to involve one in a maze of absurdities, but I have had too little experience with pupils in the calculus to speak positively upon this point.

20. We do not teach the calculus.

21. (a) Doctrine of limits. (b) It does not.

22. (a) That of limits. (b) Not in every case.

23. (a) Limits.

24. (a) Limits.

25. (a) The method of limits. (b) It does not.

26. (a) Limits.

27. (a) I explain and illustrate both limits and infinitesimal analysis. (b) When properly explained and illustrated, I think it does.

28. (a) The infinitesimal. (b) It does, i. e., generally.

29. Method of limits, not the Newtonian of passing to zero.

30. (a) Have been accustomed to take the limits.

31. We have no classes in calculus.

32. (a) Had experience only with infinitesimals. (b) No; certainly Olney's presentation can be improved upon.

33. (a) The infinitesimal, if properly presented. (b) Yes, when the student can appreciate mathematical reasoning.

34. (a) Teach both methods, do not favor either. (b) Yes; Lagrange's method of derived functions is considered the best in theory (Professor Shattuck).

35. (a) Method of limits. (b) No.

36. (a) Limits.

37. (a) Method of limits. (b) No.

38. (a) Limits. (b) No.

39. (a) I teach the infinitesimal, prefer it in general. (b) Occasionally a student will not accept its theories; I then try him on limits and show him their relation.

40. (a) The latter, with a sprinkling of the former. (b) The infinitesimal method is just as rigorous, when understood, as the method of limits, but it is my experience that the latter more quickly removes the logical difficulties in the way of the beginner.

41. (a) The method of limits. (b) It does, provided its relation to the method of limits be shown; otherwise not.

42. (a) The infinitesimal. (b) Students have generally preferred it to the method of limits.

43. (a) The infinitesimal. (b) It does when it is known that results do not vary.

44. (a) I use the method of limits; the method of infinitesimals is also presented. (b) One method seems to do as well as the other if properly presented.

45. (a) Method of rates (see Taylor, Rice and Johnson, Buckingham).

46. (a) Generally by limits. (b) To the first part, yes; to the second part, generally not very satisfactory to those going over the subject for the first time.

47. (a) The infinitesimal. (b) Not always.

(a) *What method of treating the calculus do you favor, that of limits, the infinitesimal, or some other?* (b) *Does the infinitesimal seem rigorous, and to satisfy the mind of the student?*—Continued.

51. (a) Method of limits; use both. (b) Not so rigorous as that of limits.
52. (a) The infinitesimal. (b) So far as I know it does.
53. We have no classes in calculus.
55. (a) The calculus is not a part of our course of study; personally, I prefer the method of limits.
56. (a) The infinitesimal. (b) Yes.
57. (a) This is elective—no students yet.
58. (a) Have used the integral.
59. (a) Infinitesimal. (b) Yes, when the student is well drilled in what should precede.
60. (a) So far, the method of limits. (b) Have not found it so, generally.
62. We do not teach anything higher than trigonometry.
63. (a) That of limits. (b) No.
64. (a) Infinitesimal. (b) Yes.
65. (a) The infinitesimal. (b) Not entirely; but the ideas of the calculus are obtained better through this than any other method.
66. (a) That of limits. (b) Not altogether so.
67. (a) The two methods named are not essentially distinct; I regard the method of infinitesimals, based upon the doctrine of limits, as the best mode of treating the subject. (b) Not unless it is based upon the doctrine of limits.
68. (a) The method of rates, passing later to the method of limits.
69. No calculus.
70. (a) Infinitesimal. (b) Not entirely.
71. (a) The method of rates, combined with the method of limits. (b) It is very little used, and only after the others have been taken up.
72. (a) Limits. (b) Students have seemed satisfied when that method has been used.
73. (a) The infinitesimal. (b) Healthful.
74. (a) Infinitesimal method for students taking brief course. (b) Generally, yes.
75. (a) The infinitesimal. (b) By sufficient explanations.
76. (a) Limiting ratios preliminary to the more direct method of infinitesimals. (b) Somewhat, but often fundamental investigations are made more intelligible to the beginner by this method.
78. (a) Limits. (b) It does when properly taught.
79. (a) Limits. (b) No.
80. (a) The method of limits. (b) Yes, if the student persists until it is conquered.
81. (a) The first at the outset. All should be introduced (see Wundt, *Logik*).
82. (a) That of limits. (b) Hardly.
83. (a) Limits. (b) Yes.
84. (a) Both limits and infinitesimals. (b) Not when the two methods are presented together.
85. Calculus is not studied with us.
86. (a) Limits, decidedly. (b) Not until the student has mastered the method of limits.
87. (a) Infinitesimal. (b) Our students seem to understand this best.
88. (a) That of limits.
89. (a) Limits. (b) No.
90. (a) The infinitesimal on account of its simplicity, but the new method by General C. P. Buckingham is excellent. (b) Not always.

(a) *What method of treating the calculus do you favor, that of limits, the infinitesimal, or some other?* (b) *Does the infinitesimal seem rigorous, and to satisfy the mind of the student?*—Continued.

91. (a) The method of limits. (b) It does not.
92. (a) Infinitesimal. (b) It does.
93. (a) The fluxionary method. (b) Not entirely; it is taught from text-book—fluxionary by lectures.
94. (a) Infinitesimal. (b) Yes.
95. (a) Infinitesimal. (b) It does.
97. (a) The German method of limits, not the popular English and French.
98. (a) The rigorous method of limits. (b) No; there is an evident loss of faith at this point for students on first reading.
99. (a) We use both. (b) Yes.
100. (a) Limits. (b) Do not teach it.
101. (a) Newtonian fluxions. (b) No.
102. (a) Limits. (b) No; I find few pupils satisfied with it.
103. (a) Do not teach calculus; favor limits.
104. (a) We use both; sometimes we prefer one to the other.
106. (a) The infinitesimal for practical use, but that of rates as a logical basis.
- (b) Not as satisfactory as the theory of rates as given by Buckingham.
107. (a) Limits for general proof and infinitesimals for doing examples. (b) No, not alone.
108. (a) Limits.
109. (a) Limits.
110. (a) The method of limits is the only logical, or rational, way of treating it; though the infinitesimal has an advantage in application. (b) No; how a quantity can have another quantity taken from it and not decrease the quantity so diminished, is the skeleton that will not down.
112. (a) The infinitesimal. (b) Yes; both rigorous and satisfactory.
113. (a) The method of limits. (b) It does not.
114. (a) Limits. (b) Not perfectly.
115. (a) The method of infinitesimals, if properly taught. (b) Perfectly so, when properly taught (Professor Peck). (a) Limits. (b) Only when explained in connection with that of limits (Tutor Fiske).
116. (a) Limits. (b) Not unless based on the theory of limits.
117. (a) Limits. (b) I do not find it to.
118. (a) We use infinitesimals. (b) Yes; in general.
119. (a) I favor the method of *fluxions*, but use the infinitesimal, mainly because I could not get a suitable text-book in fluxional method until recently. (b) Yes; better than the method of limits; I have no trouble after a little explanation.
120. (a) The method of rates (the Newtonian), using also the principles of limits in connection therewith. (b) No, decidedly no; if not established by the principles of limits.
121. (a) The infinitesimal for practical use; limits as a means to an end. (b) Yes; sufficiently so for all practical purposes.
122. (a) Infinitesimals for use; for demonstration, limits. (b) Yes.
123. (a) Infinitesimal. (b) Yes.
124. (a) We teach both methods simultaneously. Having understood thoroughly the rigor of the method of limits, the student has no trouble in handling infinitesimals, practically, in mechanical problems. (b) Yes, after he has once thoroughly understood Taylor's theorem, not as a formula for development in series merely, but as the means of determining the value of a function at one point from its value at another.
125. (a) The first, but the infinitesimal should also be given careful statement. (b) Yes, if properly presented.



(a) *What method of treating the calculus do you favor, that of limits, the infinitesimal, or some other?* (b) *Does the infinitesimal seem rigorous, and to satisfy the mind of the student?*—Continued.

126. (a) Infinitesimal. (b) Yes.

127. (a) The conception of calculus as the "science of rates. (b) To some minds it is not satisfactory.

128. (a) Limits, supplemented by the conception of rates. (b) As usually stated, no.

129. (a) The infinitesimal. (b) Yes.

130. (a) About as given in the calculus of J. M. Taylor. (b) Not in the earlier part of his course, but later. Yes.

131. (a) Limits. (b) *The students find it easier, and most college students are not very critical.*

132. (a) We use Todhunter's treatise, who employs limits in the differential calculus, and infinitesimals in the integral calculus, and we find it to work well. (b) Not at first, but later, when calculus is used in analytical mechanics and mathematical physics, it carries conviction and satisfaction.

133. (a) The infinitesimal. (b) It may seem rigorous at first, but I think ultimately he is better satisfied of its advantages as mental drill.

134. (a) Our course does not include calculus.

135. (a) Infinitesimal in the main, though with many references to the theory of limits. (b) As so taught, it does.

136. (a) I prefer the infinitesimal method, but I do not hesitate to use such assistance as can be derived from the method of limits. (b) It appears to me that it is only familiarity with the proofs that makes either method seem rigorous; but the difficulties seem no greater in regard to one than the other.

137. (a) The infinitesimal for beginners, limits for the advanced. (b) I think it does if properly presented.

138. (a) Infinitesimals at first, afterward the method of limits may be introduced. (b) With 99-100, yes.

139. (a) Limits is most mathematical, infinitesimals most easily comprehended. (b) It is satisfactory to ordinary students.

140. (a) Limits for the theory, infinitesimals for the practice. (b) No.

141. (a) Limits.

142. (a) Infinitesimal.

143. (a) I hardly know. Each has its advantages and disadvantages. I now use the method of rates as given in Rice and Johnson's treatise. (b) It does not, as usually presented.

144. (a) Limits for theory, inclusive of rates and of infinitesimals. (b) It sometimes seems to satisfy the students, but never the professor.

145. (a) The infinitesimal, but in connection with the other methods. (b) It does, if any method does.

146. We do not teach calculus.

147. (a) The infinitesimal at first; I use both to some extent. (b) Not altogether.

148. (a) That of fluxions, with demonstrations by limits. (b) No; its equations (with one exception) have never been proved true, and may easily be shown false. Its results, however, are absolutely true, as experience proves, and as may be shown by theory.

149. (a) That of limits.

150. (a) Infinitesimal. (b) It does.

151. (a) Limits. (b) It does not.

152. (a) The method of limits. (b) I don't use the method in teaching.

153. (a) Infinitesimals founded upon limits. (b) The infinitesimal method is never rigorous unless founded upon limits.

(a) *What method of treating the calculus do you favor, that of limits, the infinitesimal, or some other?* (b) *Does the infinitesimal seem rigorous, and to satisfy the mind of the student?*—Continued.

154. (a) Limits. (b) It is the practical method, but is not satisfactory, at first, to the student.

155. (a) I am decidedly in favor of the method of limits. (b) It does not seem rigorous, and does not satisfy the mind of the student.

156. (a) The infinitesimal. (b) Perhaps not at first.

157. (a) That of limits.

158. (a) Limits. (b) Yes; can be presented in a perfectly satisfactory manner.

159. (a) The theory of limits, as presented by Todhunter. (b) My experience with classes has been to the contrary. It does not.

160. (a) Limits. (b) It has not done so with my classes.

161. (a) By limits. (b) It does not.

163. (a) By limits. (b) No.

164. (a) The method of rates and fluxions, as developed by Rice and Johnson. (b) No.

165. (a) No specialty.

166. (a) Limits. (b) Yes.

167. (a) The method of rates, combined with that of limits. (b) I have not been able to make it as real to my students as I desire.

168. (a) The infinitesimal with some use of that of limits. (b) Yes; except with a few students.

(a) *Do scientific or classical students show greater aptitude for mathematics?* (b) *Which sex?*

1. (a) No special difference is noticed.

2. Classical.

3. Scientific.

5. Classical.

6. (b) Male.

8. (a) No difference; our Civil Engineering students have shown most aptitude. (b) Male sex.

9. (a) I think it depends on talent.

10. (b) Male, generally.

11. (b) Girls for rote work, boys for original work.

12. (a) Classical. (b) Male.

15. (a) I observe little or no difference.

16. (a) Classical. (b) Male.

17. (b) Male.

20. (a) Scientific. (b) Male.

21. (a) Classical. (b) With us, females.

23. (a) Scientific.

24. (a) Scientific. (b) Equal.

25. (a) Scientific. (b) Male.

26. (a) Scientific. (b) Boys.

27. (a) Scientific, as a rule.

28. (a) Scientific. (b) Male.

29. (b) I note no material difference in our work.

30. (a) I am inclined to think scientific. (b) Male, but sometimes female.

31. (a) Have not been able to note great difference. (b) In my classes the young ladies have, as a rule, excelled.

32. (a) Scientific. (b) The male.

- (a) *Do scientific or classical students show greater aptitude for mathematics?* (b) *Which sex?*—Continued.

33. (a) The greater the drill, the greater the aptitude for anything. Therefore classical. (b) The young men for persistent, the young ladies for instantaneous grasp.

35. (a) Scientific. (b) Male.

36. (a) Good students in either course. (b) Males as a rule.

37. (a) Classical. (b) Males.

38. (a) I would say classical. (b) There are more males than females.

40. (a) Difficult to answer. (b) The ladies are not inferior.

42. (a) Generally the scientific. (b) I see no difference.

43. (a) No difference noted. (b) Males average higher, but a female often stands first.

44. (b) A greater number of males succeed, but a few females excel.

45. (a) Cannot see any difference.

46. (a) Classical students not required to study analytical mathematics. No comparison is possible, as we have no preparatory school. (b) Young men form the larger part of our higher classes. As far as comparison is possible, the two sexes show about equal aptitude for the study.

47. (a) Our best have been classical here, but the reverse has been my experience elsewhere. (b) Girls in the text-book; boys outside.

49. (a) No difference. (b) Male.

51. (a) There is no difference. (b) Some of our best students in mathematics have been young ladies.

52. (a) No difference. (b) Interest about equal.

53. (a) The scientific. (b) Male.

54. (a) Generally scientific. (b) About equally.

55. (a) The former. (b) No perceptible difference as to sex.

56. (a) Classical. (b) Gentlemen.

57. (a) Generally the former.

59. (b) Equal in *applied*, but more males in *pure*.

60. (a) Scientific.

61. (a) Classical.

63. (b) Male.

64. (a) Scientific.

65. (a) Scientific. (b) Male

66. (a) Classical students.

73. (a) Scientific (b) No difference.

75. (a) Good students in other departments are equal in mathematics as a rule. (b) It is rather difficult to answer directly. The ladies average fully as high as the gentlemen.

76. (a) Scientific. (b) Male.

77. (a) Classical. (b) Male.

79. (a) Classical, thus far.

80. (a) Classical.

82. (a) Scientific, usually. (b) I find little difference.

83. (a) Classical.

84. (b) The male sex.

85. (a) The classical, as a rule; our very best mathematical students have been scientific.

86. (a) No difference.

87. (a) No classical. (b) Young men.

88. (a) Classical.

90. (a) Scientific. (b) Males.

91. (a) Scientific. (b) Male for analysis, female for book work.

- (a) *Do scientific or classical students show greater aptitude for mathematics?* (b) *Which sex?*—Continued.

92. (a) Scientific or philosophical. (b) Nearly alike on the text-book work. The gentlemen seem more successful in *original* investigation. May not the reason for this be found in the fact that it has been assumed for an indefinite period that woman is not capable of doing such work, and so she has not been required to do it, thus leading to a dwarfing of this part of her mind?

93. (a) Seem not to divide on this line. (b) See no difference. Few girls elect calculus.

94. (a) No appreciable difference. (b) The females do closer work on lessons and tasks assigned.

95. (a) Scientific.

97. (a) Classical, and students of the exact (not merely scientific) sciences. (b) Male.

98. (a) Scientific. (b) Male.

99. (a) Scientific.

100. (b) Male.

101. (a) Scientific. (b) Male.

102. (a) The scientific. (b) Males in quantity, females in quality.

104. (a) No difference, high classics generally carry high mathematics.

105. (a) No difference. (b) Hard to say. Boys a little better reasoners.

106. (a) Classical. (b) On the whole, young men.

108. (a) Can't say. (b) Males.

113. (a) Scientific.

114. (a) Classical students frequently show a greater aptitude, but scientific students, after having a practical end in view, more frequently become accomplished mathematicians.

115. (a) Scientific (Professor Peck). (a) Mixed. (b) Male (Tutor Fiske).

116. (a) Classical generally.

117. (a) Scientific. (b) Male.

117. (a) We see little difference.

119. (a) Classical. (b) About equal.

121. (a) Scientific.

122. (a) Scientific.

123. (a) Rather the classical. (b) Young men.

124. (a) Scientific. The mathematics in the classical course ends with trigonometry. (b) Only a few girls take mathematics. Can't answer satisfactorily. Some girls do excellent work. I doubt whether sex has much to do with natural mathematical ability.

125. (a) Other conditions being equal, no difference. (b) No difference, following similar preliminary training.

127. (a) Difficult to decide. (b) Not much difference.

128. (a) Our experience not a fair test—students have been so largely classical. (b) Male, on the whole.

129. (a) Classical.

130. (a) Scientific.

131. (a) About the same. (b) Male.

132. (a) No difference in aptitude, but classical students find no time for extended courses. (b) Comparatively few females excel, though some are as good as any of the males.

133. (a) Very little difference. (b) Males.

134. (a) Scientific students. (b) Male.

135. (a) Classical students. (b) No experience.

136. (a) Scientific or technical.

137. (a) So far as we can test it, classical.

(a) *Do scientific or classical students show greater aptitude for mathematics?* (b) *Which sex?*—Continued.

139. (a) No difference in aptitude. (b) No difference in sex.
140. (a) Classical are more frequently the best.
142. (a) Classical. (b) The male by a large percentage.
144. (a) Classical.
145. (a) Scientific.
146. (a) I notice no difference.
147. (a) The classical are superior. (b) No difference.
148. (a) The scientific, but, for the reason (I think) that those who dislike it elect a literary course.
149. (a) Classical, I think. (b) Male and female equally is my observation here.
150. (a) Classical. (b) Males.
151. (a) Classical. (b) Male sex.
153. (a) Scientific. (b) Male.
154. (a) We have no classical students.
155. (a) Scientific.
156. (a) Scientific.
157. (a) Scientific.
159. (a) Scientific.
160. (a) Scientific.
161. (a) The classical. (b) Male.
162. (a) I think classical. (b) Male.
164. (a) Scientific. (b) Male.
166. (a) Classical. (b) I do not see any difference.
167. (a) Generally the scientific. (b) Males as a rule, at least in higher branches than elementary trigonometry.
168. (a) The classical.

(a) *In what other subjects are good mathematical students most successful?* (b) *In what least successful?*

1. (a) Good students in mathematics generally stand well in all other studies.
4. (a) As a rule none but the better students pursue mathematics more than two years. Good mathematical students are successful in the scientific branches taught here. (b) In English.
5. (a) Geography, logic, history, chemistry, and natural philosophy. (b) Grammar, rhetoric.
8. (a) In logic and in the physical sciences. (b) Ancient languages and English literature.
9. (a) In philosophy, chemistry, analytical mechanics, geodesy, etc. (b) I have not observed.
10. (a) I can not say. (b) Do not know; hard to determine.
11. (a) Am not certain; should say physics and ancient languages. (b) Can't say.
12. (a) I do not know certainly, but I have never noticed any inverse relation between linguistic and mathematical endowments. Chemistry and mathematics are less friendly.
15. (a) Scientific subjects, especially physics. But I observe that good mathematicians usually do well in almost any subject which interests them. (b) Subjects which involve much "committing to memory."
16. (a) A good student is successful everywhere. I have found that my best students in mathematics were, as a rule, "best students" in other departments.
17. (a) In any subject in which continued reasoning is necessary. (b) I am unable to specify.

(a) *In what other subjects are good mathematical students most successful?* (b) *In what least successful?*—Continued.

18. (a) In natural philosophy, in metaphysics, and generally in Greek. (b) Literature.

19. (a) They do equally well in Latin, as a rule. (b) English.

20. (a) Mechanics.

21. (a) A student good in mathematics is apt to be successful in all branches.

22. (a) My experience goes to show that a student who is good in mathematics is capable of coming off with good standard in almost any other study. I have known a few apparent exceptions. (b) In languages.

24. (a) Sciences. (b) Classical studies.

25. (a) Physics.

26. (a) Physics, logic, chemistry. (b) Rhetoric.

27. (a) In engineering, physics, astronomy. Mathematical training seems to make lawyers more successful in the clear statement of their cases. (b) Literary pursuits.

28. (a) In mental, moral, and natural philosophy. (b) In belles-lettres.

30. (a) In almost every other. (b) Perhaps, literature.

32. We can hardly give an intelligent answer to this question with our grade of work.

33. (a) Mathematics, as we are compelled to teach it, is largely mechanical; therefore, in subjects not requiring great originality. (b) Answered.

35. (a) In engineering. (b) In languages.

37. (a) Varies with the student.

38. As a rule, our mathematical students are excellent in all their studies. Languages are not unfrequently hard for good mathematical students.

39. (a) Greek, Latin—often—mainly—various forms of graphics. (b) Scientific research, i. e., natural sciences.

40. (a) The various branches of natural science, metaphysical studies.

41. (a) Usually in all other subjects of our course. (b) Occasionally in languages.

43. (a) We often have fine work upon topics related to general geometry.

44. (a) Chemistry, physics, languages. (b) History, literature.

45. (a) Generally in whatever is undertaken, I believe success in any branch is in proportion to application.

46. (a) Whatever they undertake. (b) Whatever they give the least attention to.

47. (a) Logical. (b) Linguistic.

49. (a) As a rule in all subjects requiring judgment, reason, discrimination.

(b) In subjects requiring the memory as the chief element of the mind.

49. (a) Sciences. (b) Languages.

50. (a) Languages. (b) History.

51. (a) All others, that is, according to circumstances.

52. (a) Our good mathematical students are good in languages and sciences.

53. (a) Chemistry and physics. (b) Have not noticed.

54. (a) Some in one subject and some in another, according to native aptitude and application.

55. (a) In chemistry, physics, and logic. Good mathematical students rarely show weakness in any study. (b) Literature (and modern languages?).

56. (a) Natural science. (b) Language.

57. (a) Natural science.

59. (a) The majority of good mathematical students are good in everything else, but sometimes a mathematical mind fails in letters, and vice versa, as some appreciate only demonstrative reasoning, and some moral.

60. (a) Physics, astronomy, and natural science. (b) Languages.

(a) *In what other subjects are good mathematical students most successful?* (b) *In what least successful?*—Continued.

63. (a) I find good mathematical students successful, generally, in all other subjects.

66. (a) In most subjects.

68. (a) Our best students are about equally successful in all mathematical branches.

69. (a) Natural science. (b) Can't say.

70. (a) Languages. (b) History and literature.

73. (a) Physics and astronomy. (b) My best mathematicians are best in other lines.

74. (a) Since I have observed here (four years), the best mathematical students are usually also among the best in all studies; otherwise in natural sciences, English and Greek, history and political science. (b) Languages.

75. (a) The good mathematicians are those whose general standing is high, but of course there are exceptions to this; I should say that they are more likely to excel in the sciences, logic, and metaphysics.

76. (a) Chemistry, logic, mental science. (b) Language, history, rhetoric, oratory.

79. (a) Languages, I should say, in general.

80. (a) Latin and science. (b) History and literature.

82. (a) As a rule, I think, in all subjects, although occasionally I find one who is weak in language and literary studies.

84. (a) Physics and mechanics. (b) The languages.

86. (a) No special difference so far as I know.

87. (a) Chemistry, physics, and applied mechanics. (b) Languages.

88. (a) Our records show that good mathematical students are successful in all other subjects.

89. (a) In all other subjects taught in the school.

90. (a) In historical studies, natural philosophy, and mathematical astronomy. (b) Literary, but not always.

91. (a) In the lateral sciences, *e. g.*, physics, chemistry; also in logic. (b) Languages and history.

92. (a) As a rule, I think, in the sciences, and especially in original investigations in science. (b) So far as my observation goes, in languages, as a rule.

93. (a) With rare exceptions they are good in all the subjects. The converse is not so general, *i. e.*, students often excel in one or two departments without excelling in mathematics.

94. (a) They average well all around. (b) No uniformity.

96. (a) Draughting, physics, chemistry, logic.

96. (a) As a rule, those good in mathematics are good in all others, but especially in natural sciences, psychology, and logic.

97. (a) In all the more introspective, and such as require prolonged and strenuous thought, not mainly observation (like stone—or bug—lore). (b) In these latter so-called experimental sciences.

98. (a) Applied arts, engineering, physics, etc. (b) Languages, metallurgy, analytical chemistry.

99. (a) Philosophy. (b) Composition.

101. (a) Philosophical. (b) Linguistic.

102. (a) In natural sciences, history, geography, logic. (b) Languages.

104. (a) All scientific pursuits, drawing, arts, generally.

106. (a) In such as require concentration of mind, and close reasoning. (b) If in any, in such as depend upon observation and experiment.

107. (a) Generally in all others, if they are interested.

109. (a) Natural philosophy, chemistry, Greek, Latin. They can generally do well, wherever they try. (b) English, political science.

(a) *In what other subjects are good mathematical students most successful? (b) In what least successful?—Continued.*

110. (a) My observation has been that where students were good in mathematics, they were good in all their other studies.

111. (a) Logic and analytical studies.

112. (a) They generally stand high in all subjects.

113. (a) As a rule they are successful in all other studies; more so in metaphysics, theology. (b) The higher study of literature.

114. (a) Very difficult to generalize. Many excellent mathematicians are "all-around" men. Others excel in science, and are least successful in languages and speculative subjects.

115. (a) A good student in mathematics is generally a good student in all other branches (Professor Peck).

116. (a) Generally in logic and psychology.

117. (a) Mechanics, physics, chemistry, logic. (b) Classics.

118. (a) They are generally good in all subjects. (b) Subjects requiring memory only.

120. (a) Chemistry (including heat, physiology, electricity, and magnetism, mineralogy and geology, engineering, ordnance and gunnery, and law. (b) Drawing, Spanish, and French, relatively. Good mathematical students are generally good in all other branches (Professor Bass, professor of mathematics).

Charles W. Larned, the professor of drawing at West Point, answers as follows: I differ somewhat from the inferences to be drawn from the answer to this question by the professor of mathematics.

In so far as any influence is to be implied by mathematical proficiency upon other studies, an examination of the standing of the last five graduating classes tends to show very positively that law belongs to the category of those studies in which there exists the greatest discrepancy, and this, notwithstanding that law is studied two years after mathematics is completed and when habits of study and ability to master a wider range of subjects is more highly developed by the study of other natural scientific studies.

There is a much greater range of discrepancies also between the group of studies comprised under the head of chemistry (which includes electricity, mineralogy and geology, and heat) and mathematics than would naturally be inferred from the group of marks. Even in natural philosophy the aggregate discrepancy is somewhat greater than I had supposed probable.

The standing of the last five graduating classes of 1884, 1887, 1886, 1885, and 1884 in law, chemistry, drawing, English, and French were reduced to the same standard, and the discrepancy between these and mathematics in each case were obtained and the average discrepancy for these classes is as follows:

*Discrepancy between standing in mathematics.*

|      | Law | Chemistry | Drawing | French | English |
|------|-----|-----------|---------|--------|---------|
| 1884 | 100 | 100       | 100     | 100    | 100     |
| 1887 | 100 | 100       | 100     | 100    | 100     |
| 1886 | 100 | 100       | 100     | 100    | 100     |
| 1885 | 100 | 100       | 100     | 100    | 100     |
| 1884 | 100 | 100       | 100     | 100    | 100     |

It is not difficult to observe that a marked distinction exists between the standing in law and drawing. The standing given includes free-hand drawing up to occupying one-fourth of the course. In this the possession



(a) *In what other subjects are good mathematical students most successful?* (b) *In what least successful?*—Continued.

of natural graphical talent exercises a much greater influence in producing discrepancies in standing. In technical graphics, however, throwing out a few men, perhaps one-half dozen in each class, with pronounced natural ability, standing in plane and descriptive geometry has a decidedly beneficial influence on standing in drawing. In other respects, intelligence, whether mathematical or liberal, will tell in the work. Leaving out four or five exceptional men in each class the discrepancies in drawing, even with free-hand included, fall below those of French, English, and law.

121. (a) Physics and astronomy. (b) Latin, French, etc.

122. (a) First-rate mathematical students generally do well in all other studies.

123. (a) In mathematics of physics. (b) Possibly the biological sciences and languages.

124. (a) My experience is that a man who is good in mathematics has mental ability sufficient to make any subject of an ordinary college course comparatively easy. Good in mathematics—good everywhere.

125. (a) Applied sciences, of course—astronomy, physics, logic, and metaphysics. (b) Languages and literature, sometimes. Still hardly think that is true, as a rule.

126. (a) Advanced work in physics and engineering. (b) Our best students in mathematics are best everywhere.

129. (a) Good mathematical students are good in all their work. (b) Rarely unsuccessful in any line of study.

130. (a) Physics, astronomy, logic.

131. (a) Classics, sciences, but there are many exceptions. (b) English, probably.

133. (a) Think that, on the whole, our best mathematical students are best, generally, in other studies.

134. (a) Sciences.

136. (a) Greek is often combined with mathematics.

137. (a) They are generally good all around. (b) In languages, but only in exceptional cases.

138. (a) In all other subjects. (b) None.

140. (a) Physics and astronomy. The good ones are also usually good in classics and everything.

141. (a) Generally also in the classical studies.

142. (a) Physics, chemistry, logic. (b) Moral and mental philosophy.

143. (a) All subjects requiring accurate thought. In our college this is especially noticeable in mental and moral philosophy. (b) Those requiring mere memory.

144. (a) Usually in all others.

145. (a) Some in one, some in another. No general rule. (b) No general rule.

146. (a) In this they differ, though they are possibly better in scientific studies. (b) Languages.

147. (a) I have not observed that a successful student in mathematics is more apt to succeed in one subject than he is in another, except where the subject rests on mathematics.

150. (a) Generally in everything else.

151. (b) Belles-lettres.

152. (a) Naturally in subjects depending upon a knowledge of mathematics, and generally in whatever else they may study.

153. (a) In logic, physics, engineering, medicine. (b) Languages.

(a) *In what other subjects are good mathematical students most successful? In what least successful?—Continued.*

154. (a) In all branches that require accurate observation and close reasoning. (b) In languages.

155. (a) In branches of natural science. (b) In the languages, I think.

156. (a) In logic and, as a rule, the natural sciences.

157. (a) They are apt to be more successful in all subjects connected with the sciences than in the study of languages.

158. (a) As a rule, all students standing very well in mathematics will achieve success in any other subject. I have seen but few exceptions.

159. (a) In moral and mental philosophy, logic and civil law. (b) Synthetic languages.

160. (a) In the mathematical sciences. A good mathematical student is good at everything he undertakes.

161. (a) Physics and chemistry. (b) Languages and history.

162. (a) Oftener classics.

163. (a) Engineering and physics. (b) Languages.

164. (a) In any subjects requiring reflection. (b) Those requiring perception and memory only.

165. (a) Logic, chemistry, philosophy, political economy, and astronomy. (b) Language.

167. (a) I believe that a really first-class mathematical student is generally successful in nearly all subjects, but those a grade lower are most likely to excel in the physical sciences than in other lines. (b) Perhaps in belles-lettres.

168. (a) I don't think I can tell, for there is such diversity; yet I think that those who are good in mathematics are good all-around students, as a rule.

*What is the relative prominence of mathematics in your course of study as shown by hours per week and per year?*

1. In classical and scientific courses the same number of hours is given to mathematics as to any other study. In the engineering course about twenty-five per cent. more.

2. About one-fourth part of the class-time is devoted to the study of mathematics.

3. No study has more attention, and some have less.

4. Five hours per week out of sixteen hours for recitation and lectures are devoted to mathematics for three years; the last year three hours per week during the year.

5. More prominence given to mathematics than to any other study.

6. Large.

7. Occupies more time than any other subject.

8. In classical course one-fourth of student's time is devoted to mathematics; relatively more in scientific and civil engineering course.

9. The principal studies in our college receive equal attention; mathematics one hour and a quarter daily.

10. More stress on mathematics as a whole than upon any other subject. I think.

11. Mathematics takes one-fourth of the time in the scientific course, one-seventh in the literary, and over one-fifth in the classical.

12. It is a Greek, and is on a par with Latin and physics.

13. Considered of fundamental importance and continued throughout the four years of study; twenty hours per week for the four classes (pure mathematics only).

14. During the year, four hours per week out of a total of fifteen hours.

15. In the classical course about ten per cent. of the work is in mathematics, and in the scientific course about fifteen per cent. I have counted only the prescribed work and the pure mathematics, so-called.

*What is the relative prominence of mathematics in your course of study as shown by hours per week and per year?—Continued.*

16. It has the same prominence as do the classics.
17. Preparatory, two-thirds of the entire work done is mathematics; first year, one-half; second, about two-fifths; third, one-fifth; fourth, only applied mathematics.
18. One hour of mathematics each day, *i. e.*, six hours per week; about three and three-fourths of other studies.
19. Our regular course of study practically covers five years, divided into three terms each; mathematics occupying one-third of each term for the ten terms ending with first term of the Junior year (Professor Gordon). In the early years of the course, equal to any other subject except English (Professor Draper).
20. Mathematics and classics each occupy five times as many hours as science.
21. Twenty per cent.
22. Daily recitation required of every student.
23. It is of the first prominence.
24. No special prominence observed.
25. Six hours per week; about one hundred and eighty per year.
26. One-fifth of time.
27. Mathematics has seventeen hours per week; the ancient languages, fifteen hours per week; English, twelve hours per week.
28. One-fourth of all the time during Freshman and Sophomore years is devoted to pure mathematics; and one-tenth of all the time in the Junior and Senior years.
29. Mathematics extends through two-thirds of the course. Takes about one-fourth of time during that period.
30. The time spent is about the same as in the average college.
31. More time is given than to any other one topic.
32. It ranks with the natural sciences and the ancient and the foreign languages.
33. As prominent as any other chair, if not more so.
34. Freshman year, three-fifteenths; Sophomore year, three-fifteenths; Junior year, two-fifteenths (elective); Senior year, two-fifteenths (elective).
35. In some courses one-third the time for one year; in others one-third the time for seven terms out of twelve, with applied mathematics for eleven terms more. In both, eighteen units out of thirty-six.
36. Nearly one-third in Freshman and Sophomore years.
37. The same as other studies; three and three-fourths hours per week.
38. One year's work is required of all students. Four years are required of mathematical students. Many elect mathematics for one or more years.
39. The time is about equally distributed between Latin, Greek, modern languages, and mathematics.
40. Different in the various courses. Mathematics is more prominent in the scientific course, claiming about one-fourth the student's time (perhaps one-third).
41. Freshman year twenty-one hours out of sixty-one, 798 per year; Sophomore eighteen out of fifty-four, 684 hours per year; Junior thirteen out of sixty, 494 per year. In this estimate two hours of preparation are usually reckoned with each hour of recitation.
42. Sixteen hours per week.
43. Upon an equality with Latin and Greek.
45. It is taught five hours per week until the end of the Sophomore year.
47. Co-ordinate with Latin and Greek.

*What is the relative prominence of mathematics in your course of study as shown by hours per week and per year?—Continued.*

44. About one hour out of every four.
49. Five hours a week for two years and one year additional, which is elective.
50. About the same.
51. As great as that of any other subject.
52. Equal with language and science, until Junior year.
53. Has more time than any other study.
55. Five out of fifteen per week for three years of the course. No mathematics in the last year of the course.
56. It receives more time than any other subject taught.
57. First.
59. About two-fifths of the time in the various schools.
60. As about five to four in comparison with language and natural science.
61. First.
62. It ranks with any other study in prominence.
63. It is desired to make it equally prominent with other subjects.
64. One hour daily in class-room.
65. Four hours per week are devoted to mathematics throughout the course. It receives about equal attention with any other subject.
66. Quite as prominent as classics.
67. Under our "group" system, under-graduate students who include in their "group" of studies a minor course in mathematics devote one-third of their time for one year (as measured by hours per week) to mathematics; those who take a major course in mathematics devote to it one-third of their time for two years. The whole time of an under-graduate course is three years. A student need not include any mathematics in his group. Our entrance requirements include trigonometry and some analytical geometry.
68. About one-fourth of required time is devoted to pure mathematics.
69. Stands near bottom of the list.
70. Classics, science, and mathematics have equal prominence.
71. During the first year for all students, thirty-three and one-third per cent. of recitation periods is for mathematics. The time for preparation would be larger. During the second and third years the engineers gave about twenty-five per cent. to pure and twenty-five per cent. to applied mathematics. During the Senior year about twenty-five per cent. to applied mathematics. Other students give but little time to mathematics after the first year.
72. Four hours out of fifteen per week in Freshman year.
73. Thirty-three and one-third per cent.
74. Freshman year four hours per week, i. e., twenty-five per cent. is required throughout the year. Four hours per week elective is offered in Sophomore and Junior years.
75. Five hours per week for the first two years of the course.
76. It stands third in the course.
77. Less prominent than the classics, except in the academy and in the inductive science courses.
78. It stands on the same level with Latin and Greek—our courses being like those of Harvard College) elective.
79. It is on an equality with Greek.
80. Algebra, plane geometry, plane trigonometry are required, five recitations per week during Freshman and Sophomore years. Mathematics is elective three hours per week during rest of course.
82. Five hours per week for thirty-eight weeks per year, or nearly one-third of the whole work.
84. In first year, one-fourth the time; second and third, one-fifth; none in the last.

*What is the relative prominence of mathematics in your course of study as shown by hours per week and per year?—Continued.*

85. One-third of the time.
86. Of required work, mathematics has about fifteen per cent. out of the fifty-two hours weekly.
87. Our students average in three years six and one-third hours per week of mathematics, to four and one-half of language, to four of physics and chemistry, mineralogy and geology altogether.
88. It is different in the different years. For the four years it is about one to ten.
89. One to six.
90. About par.
91. The hours are about equal, taken as a whole. For the degree of B. S. they far exceed.
92. A high importance; fifteen terms (including the preparatory course); five hours per week, forty weeks per year, for five years.
93. Sub-Freshman year, two-sevenths of entire work; Freshman year two-ninths; Junior year (elective) one-fourth; Senior year (elective) one-sixth. This does not include mechanics, surveying, and other applied mathematics.
95. Four hours per week; most other studies (non-professional), three.
96. Daily recitations, one-half hour each.
97. In the scientific courses it is first; in the classical and literary, second (Latin and Greek, respectively, English first).
98. Mathematics is the ground work of the institution, preparatory and coincident with the courses in engineering.
99. Two hours daily devoted to mathematics during the session of ten months.
100. Fourteen-sixtieths of the four years' course.
101. Twenty-five per cent.
102. About one-third of the whole time; ten hours per week, 480 hours per year.
103. Each class averages five hours per week, per year.
104. Same, no prominence.
105. In the preparatory course, total hours per week fifteen; mathematical average, three and one-third. In college classes, total hours per week, fifteen; mathematical average, two and eleven-twelfths.
106. The mathematical course for the majority of our courses is completed the Freshman year, having five-sixteenths of the time.
107. Leading study.
108. Five twenty-fourths of the whole.
109. Mathematics ranks with Latin and Greek throughout, each getting four-fifteenths of the time in first two years; elective in third.
110. Until this year, more than half the time was given to mathematics; now, perhaps, one-third.
111. We require two and one-half hours per week.
112. Considering the hours devoted to mathematics, it ranks with any other subject.
113. Mathematics and Latin have each three hours a day.
114. Freshman year, one-third; Sophomore year, four-fifteenths; Junior and Senior years, optional.
115. The courses in my department are elective. Question cannot well be answered.
116. Five hours per week out of fifteen in Freshman year; three hours per week out of fifteen, Sophomore year for classical; four out of fifteen for scientific.

*What is the relative prominence of mathematics in your course of study as shown by hours per week and per year?—Continued.*

117. Freshman year, five hours per week out of sixteen; Sophomore, five out of seventeen in first term, and three out of eighteen, second term.

118. In scientific course sixteen one-hundredths of whole time, or twenty-eight one-hundredths, including descriptive geometry and mechanics and astronomy. In classical course thirteen one-hundredths and sixteen one-hundredths.

119. Four hours per week required during the entire Freshman and Sophomore years, and the second term of the Junior year. From two to six hours per week may be elective during the other terms.

120. During the first year, time devoted to mathematics is to time devoted to modern languages as four and one-half is to three. During the second year, time devoted to mathematics is about the same as the time devoted to languages and drawing.

123. It is on an equality with the subjects taught in the other departments.

124. Mathematics is one of our most important subjects. Three professors give jointly forty-five hours per week to mathematical instruction, for twenty-six weeks, and thirty-nine hours per week the remaining eleven weeks of the session.

125. Freshmen five-fifteenths, Sophomores three-fifteenths, Juniors (elective) two-fifteenths, Seniors (elective) two-fifteenths.

126. It occupies about one-third of the whole course.

127. Full work in all subjects fifteen hours per week. In mathematics five hours per week whenever any mathematical subject is studied. In the preparatory department algebra is required in all the courses three terms (one full year), and in the science courses four terms. Plane geometry is required through the last term of the Senior preparatory year. Then, in the college course, we have solid geometry, trigonometry, surveying, analytical geometry, and calculus, one term each. A second term of analytical geometry and calculus is required of the scientific students; and in the philosophical course, students elect between a second term of calculus and practical chemistry.

128. All courses are four or five hours a week. In classical course, mathematics have 378 hours, required and elective, out of a total of 4,077 hours.

129. Two hundred and seventy hours distributed through two years with opportunity of election in addition.

130. Four hours out of fifteen per week during two years for all the class; then four out of fifteen during another year for electives.

131. One-fourth up to second term of Sophomore year; from that point all subjects in the course are elective.

132. We have too many courses to make any general statement.

133. About the same as ancient languages.

134. Greater than others, except English.

135. Freshman year, five hours out of eighteen per week.

136. Mathematics is on an equality with all other courses.

137. A little more than one-fourth of the student's time is given to mathematics in Freshman and Sophomore years; a little less than one-fourth during the remainder of the course.

139. Full course, four hours per week.

140. About twenty-five per cent. of total.

141. On a par with the classical.

142. First in the course.

143. Pure mathematics thirteen and six-tenths per cent. of required work. It may be thirty-four per cent. of elective work. It may be one-fifth of the whole course.

*What is the relative prominence of mathematics in your course of study as shown by hours per week and per year?—Continued.*

144. First year about thirty-three and one-third per cent. of time to mathematics; second year, fifteen per cent.; third year, twenty-five per cent.; fourth year, fifteen per cent.

145. Out of the required eighteen hours per week, literary students get in the first year five, second year three, third year nought, fourth year one and one-half; total, nine and one-half out of seventy-two; scientific students get in the first year five, second year four and one-half, third year four and one-half, fourth year one and one-half; total, fifteen and one-half out of seventy-two.

146. We regard it of greatest importance.

147. In the preparatory course one-third of the study is mathematical, i. e. 185 hours a year out of 555. The same in the Freshman year. In the Sophomore year 135 hours out of 555. After that, none.

148. Twenty-five per cent. of the student's time is devoted to mathematics until he completes the Sophomore year. Besides, the students in engineering devote twelve and one-half per cent. of their time in Junior year to mathematics.

149. About one-fourth the time is devoted to mathematics.

150. Mathematics to science about equal; mathematics to language about four to one.

151. About the same time is given to mathematics as to other branches, viz. five recitations per week, except in last year, three times.

152. Mathematics, Latin, and Greek have each four hours per week for Freshman and Sophomore years; no other subjects have as much time. After Sophomore year mathematics is elective.

153. More prominent than any other subject except English and equal to that.

154. It stands first.

155. It is as prominent as any other branch of study. The Junior class, with which the college work properly begins, has five recitations per week, each one hour long. The intermediate class has four per week, the Senior has three per week, and in applied mathematics there are three per week.

156. About twenty hours per week, or eight hundred hours per session.

157. It is given as much time as other subjects, five hours per week in the Freshman year, five hours per week in the Sophomore year, three hours per week in the Junior year, and two hours per week in the Senior year.

158. Our system of independent schools and free elective courses enables us to give a positive statement that, as a rule (with a few exceptional years), the school of mathematics is the most largely attended school in the academic department. The number of lecture hours per week for undergraduates is thirteen.

159. Mathematics occupies a more prominent position in our schedule than any other branch.

160. First.

161. It occupies about one third of the time devoted to the course of instruction.

162. Five sections per week or nearly one-third of time for first two years.

163. It is probably on about the same footing as the other chief branches of study.

164. Our course in mathematics is very prominent, requiring one-third the student's time through the Sophomore year.

165. Three to two.

166. One-half.

167. Classical course: Freshman year, one-third of time required; Sophomore year, one-third elective; Junior year, one-ninth elective. Scientific course: Freshman year, one-third required; Sophomore year, two-ninths required,

*What is the relative prominence of mathematics in your course of study as shown by hours per week and per year?—Continued.*

one-ninth elective; Junior year, one-ninth required; Senior year, one-ninth elective.

168. Almost the least prominent thing in the course, as ours is classical, with a leaning to natural sciences.

(a) *Do you favor memorizing rules in algebra?* (b) *What reforms are needed in teaching the same?*

1. (a) No.
2. (a) No. (b) It ought not to be taught to such young boys, who contract the incurable habit of learning it by rote.
3. Principles, but not rules.
4. (a) No. (b) Rules and principles should be deduced from examples; a more thorough drill in algebraic language, especially in the meaning and use of signs, exponents, etc.
5. Do not use text-book too closely.
6. (a) Yes. (b) More practical application should be given.
7. No.
8. No.
9. (a) I prefer formulae. (b) More thoroughness and better understanding of elementary principles, with reviews and drilling.
10. (a) No. (b) Algebra should be taught just as arithmetic, wholly by the analytic method.
11. (a) Some of the rules. (b) I do not know.
12. (a) To a limited extent. (b) More of the spirit and reason and less mere mechanical solution.
13. (a) No. (b) The modern methods, as determinants, etc., should be introduced as soon as possible.
14. (a) Yes.
15. (a) No. (b) A larger number of simple problems; a less number of difficult demonstrations, such as those in logarithms, the binomial formula, etc.; an earlier introduction to the methods and notation of the calculus.
16. (a) No.
17. (a) Very little. (b) Anything which will make it less a collection of dry bones, and more a living and beautiful science.
18. (a) Yes.
19. (b) By proper classification the number of propositions could be materially reduced and the number of important theorems and constructions for original work could be materially increased. (Professor Gordon). (a) No. (b) More attention should be paid to explaining and illustrating the principles involved in operations, and the embodying of questions to test the understanding of those principles; e. g., why  $x - b = 10$  is equal to  $x = 10 + b$ ; why does  $+ \times = -$  etc. (Professor Draper.)
20. (a) Yes. (b) That the sense of the rules shall be known when the memorizing is complete.
21. (a) No. (b) Teaching needs to be less mechanical. The reasons for processes need to be taught more.
22. No; the inductive method should be used first.
23. a Yes.
24. No; thorough drill in substituting numerical quantities for literal.
25. a I do not. b In teaching the elements as few formal demonstrations as possible should be used—first a working knowledge, and then philosophy.
26. a Do not. (b) Practical examples.
27. No; more attention to fundamental principles, clear teaching why signs are changed in transposition, etc.



(a) *Do you favor memorizing rules in algebra?* (b) *What reforms are needed in teaching the same?*—Continued.

28. No; more prominence to principles and less of method. Students should do more private work.

29. No; it should be freed from its mechanical character. Algebra should be seen.

30. Not much; less memorizing, more analysis, more thoroughness.

31. We require the principles involved, rather than the exact words of a rule.

32. Yes; only the most important rules and theorems should be memorized, but those *thoroughly*.

33. Emphatically *no*; more principle and why; less toughing, disgusting gymnastics.

34. No.

35. No; more familiarity with technique; less mechanism.

36. No.

37. No, sir.

38. (a) Not in general. (b) In general, I should say a more thorough teaching of the principle and reasoning of algebra.

39. (a) Yes. (b) More ought to be taught.

40. (a) Students are urged to state operations and principles clearly and briefly without much regard to the text. (b) Many problems (original and otherwise) should be solved mentally.

41. (a) No. (b) More careful attention to the interpretation of literal equations.

42. (a) To some extent.

43. (a) No.

44. (a) I do not. (b) More drill on simple exercises, and fewer difficult problems.

45. (a) I do not. (b) Such as will render the mind able to deal with the principles in forming rules.

46. (a) Some of them. (b) Too little time seems to be given to the study of algebra.

47. (a) Not verbatim. (b) More rigorous proofs; more noting of analogies; more as a preparation for higher work than the solving of problems as mere puzzles.

48. (a) Yes.

49. (a) No.

50. (a) I do.

51. (a) No. (b) Methods are learned by practice, and rules evolved therefrom.

52. (a) No.

53. (a) Very few. (b) There should be more practical application of its principles.

54. (a) Not mechanically. (b) The reform of good common sense, and clear, simple presentation.

55. (a) No.

56. (a) No. (b) Keep students out of it until they have passed the discussion of arithmetic.

57. (a) Yes. (b) We need a simpler and at the same time fuller elementary book.

58. (a) At the beginning. (b) More familiarity with principles.

59. (a) Not generally. (b) The teacher should assist the pupil to make his own rules.

60. (a) No. (b) A correct reading of algebraic expressions in algebraic language, and a clear analysis of work done.

(a) Do you favor memorizing rules in algebra? (b) What reforms are needed in teaching the same?—Continued.

61. (a) I do not. (b) Require pupils to think and not to be machines or jugs to be filled.

62. (a) To a certain extent. (b) There is need of impressing the students in some way with the idea of the practical value of the study and of creating an interest in it.

63. (a) No. (b) Teachers should wait till their pupils are prepared to begin the study. It should be thoroughly taught.

64. (a) Yes.

65. (a) Yes. (b) The subject ought to be presented freer from technicalities than text-books give it. Unnecessary parts ought to be left out.

66. (a) Yes.

68. (a) No.

69. (a) No. (b) Drill on the principles and *raison d'être* for formulae.

70. (a) Yes; when once thoroughly understood.

71. (a) No. (b) The use and meaning of exponents and of the negative sign are not made as clear as they should be. More accuracy.

72. (a) No.

73. (a) No. (b) Less rules and more thinking. The less memorizing in mathematics, the better the results.

74. (a) No.

75. (a) Yes.

76. (a) No. (b) The teacher should lead with the general demonstration of each subject in form of lectures.

77. (a) No. (b) Pupils should be required more generally to demonstrate principles and work from them rather than from rules and formulae.

78. (a) We do not teach elementary geometry.

79. (a) Yes. (b) The rules should be proved as strictly as any proposition in geometry.

80. (a) No. (b) More classification of subjects.

82. (a) No. (b) The chief cause of failure in many cases is not doing enough miscellaneous examples for practice.

83. (a) Yes.

84. (a) Some. (b) None.

85. (a) A more logical arrangement of the different sections of the subject; more examples, and so given as to form a constant review of the ground already gone over; application of business methods to the revision of many rules and methods.

86. (a) No. (b) More thoroughness, practicality, and solidity of teaching—the German system.

87. (a) To some extent. (b) For a course of study like ours I think more emphasis should be put on thoroughness than extent of ground covered.

88. (a) Yes.

89. (a) No.

90. (a) No. (b) More attention to reasoning processes.

91. (a) I do not. (b) More independence of books and greater original investigation.

92. (a) No. (b) Less memorizing and more thinking, both on the part of teacher and student.

93. (a) Yes. (b) Pupils should be taught to state a proposition and follow it with a general demonstration, as in geometry.

94. (a) Yes—No! Teach the pupil to develop the principle, and to formalize his own rule for it and for his process.

95. (a) Not much. (b) Omit attempts to exhaust each subject as it comes up.

96. (a) No.

(a) *Do you favor memorizing rules in algebra?* (b) *What reforms are needed in teaching the same?*—Continued.

97. (a) No. (b) Blind, unreasoning, mechanical solution of equations needs abatement; the doctrines of forms and series, advancement.

98. (a) *No!! Rattle the bones of the algebraic skeleton, as exhibited generally in this country, and show it in its living, breathing continuity and beauty of FORM. Give a conception of the magnificent power of analysis.*

99. (a) No. (b) Much desired in text-books, at least many of them.

100. (a) Not verbatim.

101. (a) No.

102. (a) No. (b) More attention to principles and less to problems.

103. (a) For immature students, yes. (b) The method of teaching must, I think, vary under different circumstances. The principle idea should be to prevent the student *thinking it difficult*.

104. (a) No. (b) Knowledge, generally.

105. (a) No.

106. (b) I favor thorough mastering of the *reasoning* used in deducing formulæ, also memorizing for *ready use*.

107. (a) Not word for word. (b) Digesting subject as a whole, especially on review.

108. (a) No.

109. (a) No, with few exceptions. (b) A more thorough treatment of a smaller number of subjects; use of determinants, less fractions.

110. (a) No. (b) More stress should be laid on factoring, less on the theory—more of the solid work with a broader view of its application.

111. (a) We do not. (b) More mental exercise and less blackboard work.

112. (a) I do not. (b) More attention should be paid to generalization than it usually receives.

113. (a) No.

114. (a) No.

115. (a) That depends. (b) We need no reforms (Professor Peck). (a) Yes. (b) In the preparatory schools more work should be done independently of the text-book, and a more elaborate elucidation of fundamental principles should be given (Tutor Fiske).

116. (a) No. (b) In general, greater attention to accuracy; in particular, more attention to theory of exponents and radicals.

117. (a) Yes; either those of the text-book or carefully prepared ones. More "why" needed.

118. (a) Yes; so far as to secure accuracy of expression and as a mode of fixing methods clearly in the mind.

119. (a) Not to a large extent. (b) I think the student should be taught to rely upon his logical powers, rather than his memory.

120. (a) No. (b) Methods that develop a clear understanding of each process and ability to explain clearly, in place of a knowledge of rules without understanding.

121. (a) No. (b) More of the *inductive* method; and the abolition of much that may be interesting theoretically, but of little practical use.

122. (a) In very few cases.

123. (a) Yes. (b) An improvement in the speed with which the mechanical processes are done.

124. (a) Yes; saves time. (b) Get teachers who know more.

125. (a) Hardly. (b) 1. Opposite numbers ought to be given a full treatment, including all the rules for signs, with illustrations and a considerable number of examples and problems in their use, *before the literal notation is begun*. 2. In the former the reason for the use of  $+$  and  $-$  to mark the series ought to be

... Do you favor memorizing rules in algebra? (b) What reforms are needed in teaching the same?—Continued.

brought out simply and plainly, and justified. 3. The fact that in elementary algebra the letters always stand for numbers ought to be reiterated to avoid obscurity of ideas in the learner's mind. 4. The treatment of the equation should be analogous to that employed in geometry. The method of writing references to axioms, etc., at the right of the page, familiar to those who have used Wentworth's Geometry, can be employed in algebra to even greater advantage.

126. (a) No.

127. (a) Some of them. (b) Examinations of students from many places convince me that algebra should be taught more thoroughly than it is in most of the schools.

128. (a) No. (b) Explanation to be really so, and work done at time of explanation as far as possible. Many comparatively simple problems, not puzzles. New work in hour. Students to be ranked according to actual work done in problems. Much board work by entire class.

129. (a) Yes and no. (b) Better elementary text-books, better preparation on part of teacher; more rigid demonstrations of the principles of a science.

130. (a) Not in general. (b) More attention should be given to the axioms and the fundamental laws and their connection with the subject, and more attention to the theory of simultaneous equations.

131. (a) Yes, most important, but not necessarily in the words of text. (b) In the larger colleges algebra is mostly taught by tutors, who hold temporary appointments, and do not expect to make teaching their life work. Algebra as well as calculus should be taught by a permanent professor.

133. (a) Yes, but not in rigorous form. (b) Greater facility in their use with a more intelligent understanding of them.

134. (a) Yes, but they must also be thoroughly understood.

135. (a) Yes, for average student. (b) Examples given should be made more modern and practical. The theory of functions should be incorporated, beginning with simple elements. This will make the whole subject of series, etc., easy for the student.

136. (a) Very few.

137. (a) Yes. (b) Let us have live, enthusiastic, and competent teachers—such as will teach the subject rather than the text-book.

138. (a) The more important, yes. (b) For the preparatory work, greater thoroughness is much needed.

139. (a) No. (b) Explain by common sense and not by rule.

140. (a) It does no harm. (b) The current text-books are too arithmetical.

141. (a) No.

142. (a) No.

143. (a) No. (b) Less mechanical work; more thought. Students should be taught to think! think!! think!!!

144. (a) No. (b) With such text-books as Hall and Knight's Elementary Algebra and same as C. A. Smith's or Todhunter's Higher Algebra; no reform needed.

145. (a) No. (b) Greater attention to mental and intentional algebra, and to numerical and geometrical applications and illustrations.

146. (a) No.

147. (a) I recommend the memorizing of the rules, unless the pupils furnish a good working rule of their own (a rare case).

148. (a) No. (b) A more thorough drill in factoring and in fractions, and in putting into words the ideas conveyed by its symbols, equations, and operations. Also greater precision of expression.

(a) *Do you favor memorising rules in algebra?* (b) *What reforms are needed in teaching the same?*—Continued.

149. (a) I do not.

150. (a) No.

151. (a) I do not. (b) The pupils learn to do by doing. Hence, instead of having pupils waste their time on abstract demonstrations, let them solve numerous problems of every variety. It is only practice that makes perfect.

152. (a) No.

153. (a) No. (b) The founding of all algebra upon the laws of operation.

154. (a) No.

155. (a) Yes.

156. (a) Not at all. (b) The pupil should be taught to think rather than to work by rule. More thoroughness needed.

157. (a) I do not. (b) I think that the student should be required to construct his own rules as far as possible.

159. (a) But few. (b) Principles are apt to be lost sight of in the strict and close adherence to rules.

160. (a) No. (b) More thorough drill is needed, especially in the elementary principles.

161. (a) Yes. (b) Broader views of algebraic operations; more generalizing and greater exactness of language.

162. (a) Yes.

163. (a) Yes. (b) The rules should be demonstrated oftener than they are.

164. (a) No. (b) To develop the subject by original investigation.

166. (a) Yes.

167. (a) To but very slight extent. (b) Less formality and more "realism;" introduction of principles often held back until higher branches are reached, e. g., factors of direction, differentials, etc.

168. (a) Only very few. (b) More attention to problems involving principles and less to puzzles.

(a) *To what extent are models used in geometry?* (b) *To what extent and with what success original exercises?* (c) *Do you favor memorising verbatim the theorems (not the demonstrations) in geometry?* What reforms are needed in teaching the same?

1. (a) Class-room very poorly supplied, but we use the few we do possess as much as possible. (b) Such exercises are given every day and are found to be very beneficial. (c) No.

2. (a) Moderately, to explain effects of perspective on the black-board. (b) To a very moderate extent with the great majority of students, to a great extent with the best.

3. (a) When models have been used it has facilitated the work. (c) Yes.

4. (a) They are used to a limited extent. I question very much the advantages of using models, except with beginners, or rather with those who are studying works introductory to regular demonstration. (b) To a limited extent. (c) Yes; more original work; more attention to logical processes, clearness and accuracy of statement. I change the figures, i. e., their relative position, so that the demonstration shall be reasoning and not memory.

5. (a) Use them to a great extent. (b) Original exercises with fine success. (c) No; some.

6. (a) The text-book quite closely followed. (b) Some daily and with good success. (c) Yes.

7. (a) Not used. (b) Used to some extent. (c) No.

8. (a) To a large extent. (b) One-fifth of work in geometry is in original exercise; the success is good. (c) Yes.

(a) *To what extent are models used in geometry?* (b) *To what extent and with what success original exercises?* (c) *Do you favor memorizing verbatim the theorems (not the demonstrations) in geometry? What reforms are needed in teaching the same?—Continued.*

9. (a) To a considerable extent in the lower grades. (b) Very extensively and with very satisfactory results. (c) As a general thing, I am of the opinion that too little time is given to the subject to secure the best results.

10. (a) Largely, both in class-room and out-doors. (b) To no great extent and with no marked success, as yet.

11. (a) Very little. (b) The exercises in Welsh's Geometry are used. Some of them seem hard to the students, but on the whole they do fairly with them. (c) Almost verbatim.

12. (a) Only moderately. (b) They take one-third of the whole time and make the life of the work. (c) The rigorous requirement of original well-graded work from the very first.

13. (a) In descriptive geometry only. (c) It ought to be taught more from a comparative point of view.

14. (a) None. (b) To a very limited extent and not with marked success. (c) No.

15. (a) Models are largely used in geometry in three dimensions. (b) To a small extent and without marked success. (c) No; better drawing in the text-books, especially in geometry in three dimensions; more attention to the drawing of the students; less geometry, altogether; I think the importance of Euclidian geometry as mental discipline is greatly overestimated.

16. (b) To a very large extent and with excellent success. (c) It is left optional with the student.

17. (a) Very little. (b) Subordinate to a marked degree. I am trying to change this state of affairs. (c) Yes; more original work, also more comparative, not purely descriptive work.

18. (a) Always used in teaching solid geometry and in teaching conic sections.

19. (a) Forms are used in solid geometry, etc., freely, to aid the mental conception of the *perfect ideals* of mathematics (Professor Gordon). But little used in plane geometry (Professor Draper). (b) Very simple exercises, arithmetical application of geometrical principles, constructions, and problems are freely used. Very simple "catch" theorems or "corollaries" involving some absurdity are occasionally introduced to be proved. Students of ordinary intelligence generally succeed with exercises graduated to their state of advancement. Professor Gordon. About one-fifth of the time is given them. Those who do well in the text and stand questioning upon it are fairly successful with original (Professor Draper). Yes; except in a few cases where I think the theorems themselves may be improved. Would begin it in childhood of pupil; would spend more time on its elementary principles. Professor Draper.

20. (a) Models are used in solid geometry and spherical trigonometry. (b) To a limited extent and with good results. (c) Yes. That the sense of the theorem be known when the memorizing is complete.

21. (a) Very little in plane geometry; more, but not very extensively, in solid geometry. (b) Used largely and with unqualified success. (c) Yes. Using figures and figures on boards, using only propositions already proven, and many other devices of this kind need reformation.

22. (a) To a limited extent. (b) To limited extent and with good success. (c) Yes, at least to promote accuracy of expression. Greater latitude may be allowed with advanced students.

23. (a) Models are just the thing.

24. (a) Yes, except to illustrate solid bodies. (b) Extensively and occasionally.

(a) *To what extent are models used in geometry?* (b) *To what extent and with what success original exercises?* (c) *Do you favor memorizing verbatim the theorems (not the demonstrations) in geometry? What reforms are needed in teaching the same?*—Continued.

25. (a) From want of funds the supply is limited to such rude models as teacher and student can make. (b) Original exercises in connection with every study are used freely and with good results. (c) More original exercises.

26. (c) No. Variation of letters, etc., to represent angles.

27. (a) I have relied upon models to a great extent. I require all studying solid geometry to construct the five regular polyhedrons with pasteboard, giving reason why only five can be formed. (b) All classes work at original propositions. The results have shown the practice to be very important.

28. (a) No models used in plane geometry. The sphere, the cone, and a few others are used in solid geometry. (b) One-half of all the time for geometry is devoted to original exercises. Success very satisfactory. (c) Some. More original work. Demonstrations varying from those of the author should be encouraged.

29. (a) Not to a great extent. (b) They are freely used with the best results. (c) Yes, substantially; the gravest error is the memorizing of demonstrations—an evil that seems unavoidable, if text-books are employed. The ideal method is oral instruction, in which the mental movements of the pupils are under the eye of the instructor. It is a pity that a subject that has such possibilities for pupils should be so taught as to become a mere "memory grind."

30. (a) To no great extent, but figures extensively. (b) No great extent. Human nature is not original. Originality is the exception. The average student who spends his time on original exercises will fail of that discipline in method which he needs. (c) Yes, the student will become benefited in learning of a formula of words expressing truths. Stick to the Euclidian method; there is no "royal road" to geometry.

31. (a) Such as we are able to improvise.

32. (a) They are not used. (b) We intersperse them throughout the entire course of geometry. (c) While they should be memorized, the student should learn to state them also in good language of his own.

33. (a) Practically to no extent. (b) Great success when used. (c) More, much more original work and simplification of demonstrations.

34. (a) Very little. (b) One-third to one-half of work assigned. Great success with the better students. (c) No.

35. (a) Used in the study of the geometry of space, of surfaces of the second order. (b) Geometry is crowded into short time for necessary reasons; some original work done, less than would be useful. (c) Yes. Greater familiarity with definitions and axioms. The constructive method of carrying on demonstrations (i. e., omit drawing figure in full, beforehand).

36. (a) We approve of their extensive use. (b) Throughout the course; success indifferent. (c) Yes. More attention to the form of demonstration and accuracy of statement.

37. (a) Not used to any extent. (b) Original exercises are extensively used, and a greater interest in the study. (c) More attention paid to original exercises well graded.

38. (a) Models are used. (b) All the examples in Wentworth's Geometry are solved, together with selections outside. We are more successful each succeeding year. (c) No. In general, less text-book routine and more problems, not so difficult, but well graded.

39. (a) Very little. (b) Much and with great success. (c) Yes. More demonstrations should be written out, both in the elements and among original exercises.

(a) *To what extent are models used in geometry?* (b) *To what extent and with what success original exercises?* (c) *Do you favor memorizing verbatim the theorems (not the demonstrations) in geometry? What reforms are needed in teaching the same?*—Continued.

40. (a) Not very much. I prefer that students should learn as soon as possible to form mental pictures of the figures and reproduce them on the board. (b) Frequent original problems are given and are very valuable. (c) Original problems and propositions should be given in connection with the lessons from the beginning.

41. (a) They are used in teaching the higher surfaces, especially the warped surfaces in descriptive geometry. (b) A few original exercises are given with the text-book work, and with marked success. (c) No. More reliance upon the imagination for the figures and less upon the blackboard.

42. (a) Limited. (b) Very largely and with great success. (c) Not necessarily.

43. (a) A limited extent. (b) Original demonstrations are required on one day of each week of second term. (c) Yes.

44. (b) From first to last with good success. (c) I do not. More original work.

45. (a) They are all represented by the blackboard. (b) As much as possible; usually daily. (c) I do. Less demonstrations in the book; more propositions for the student.

46. (a) Geometry is with us a preparatory study. (b) Constantly, with success. (c) No. The geometrical teaching in our public schools seems to be excellent.

47. (a) To a large extent. (b) With good success when in printed form; otherwise not so. (c) Unless the student can hold himself to an equally clear form. A union of the old rigor with modern improvements.

48. (a) The usual blocks, etc. (b) About one exercise out of every ten with fair success. (c) If the text is given in definite form and is well worded, yes.

49. (a) None, excepting the elementary models. (c) In part.

50. (a) As far as needed in all cases. (b) Not much success as yet, but hopeful. (c) I do. More use of exercises and original work.

51. (a) We have about one hundred dollars' worth of models for pure mathematics. (c) No.

52. (a) For solid. (b) From the first and with gratifying success. (c) Yes. Practical application of principles in concrete problems.

53. (a, Only ordinary models, or those commonly used. (b) Occasionally with good success. (c) Yes. Less speed and more thoroughness.

54. (a) To a limited extent. (b) Made prominent and with good effect. (c) To discourage mere effort to demonstrate by memory, rather than by intuition and train of reasoning.

55. (a) As far as possible, especially in solid geometry. (b) A great many original exercises. They are the best measures of the student's ability. (c) No. Less memorizing of demonstrations and more original work.

56. (b) The representative theorems are all demonstrated by original work as far as possible. (c) Yes. Any plan that will prevent students from memorizing the demonstrations.

57. (a) Not at all. (b) Have not tried this plan yet. (c) No. Not prepared to suggest.

58. (a) Not much, and mostly in spherical geometry. (b) Have had some original work with profit. (c) Yes. More familiarity with relations of parts to each other, and less dependence on the wording of the demonstrations as given in the book.

59. (a) We usually use diagrams. (b) To considerable extent and with eminent success. (c) Yes. All have to the man who will devise means to prevent the pupil from committing to memory the demonstrations.



a) To what extent are models used in geometry? (b) To what extent and with what success original exercises? (c) Do you favor memorizing verbatim the theorems (not the demonstrations) in geometry? What reforms are needed in teaching the same?—Continued.

60. (a) To a moderate extent. (b) Largely, and with great success. (c) Yes. Guarding against use of memory too much by students in demonstrations of propositions.

61. (a) In lecturing only. (c) Yes. Thorough understanding of relatively important principles.

62. (a) To a very limited extent. (b) We use a great many original exercises with much success. (c) Yes. Too many allow students to memorize the demonstrations and thus miss the great advantage in geometry, a development of the reasoning faculties.

63. (a) So far as to illustrate triangles, parallelograms, circles, pyramids, prisms, cones, cylinders, and spheres. (b) Limited. (c) Yes. Demonstrations ought not to be memorized. Pupils ought to be shown that the truth of each proposition is established by a course of logical reasoning.

64. (a) For illustrating solid geometry, mensuration, conic sections. (c) Yes.

65. (a) Not at all. This is due to the school not being provided with models, and not to the teacher's preference. (b) They are used only occasionally, but with considerable success when used. (c) Yes.

66. (a) Whenever necessary. (c) Yes.

68. (a) Not at all in geometry, to slight extent in descriptive geometry. (b) Cadets are frequently required to submit exercises. (c) No.

69. (a) Largely. (b) Few, but satisfactory. (c) No. *Latitude*—so long as object is clearly stated, and demonstration is concise and complete.

70. (a) Very limited. (b) To a limited extent, but with good success. (c) Yes. More extended use of models.

71. (a) The spherical blackboard and models are used considerably. (b) They are being introduced with good success. (c) No; except for those students who must in order to understand them. Students should learn to depend less on the printed demonstrations.

72. (a) Definitions are taught by means of models. (b) The extent varies with different classes. The success is good with about one-third of the class. (c) No.

73. (a) Little. (b) To some trifling extent, always with profit. (c) Yes.

74. (a) Where models seem to make principles clearer, or their application practical, they are used in teaching solid geometry and spherical trigonometry. (c) Yes.

75. (b) Nearly one-half the time is spent upon original work and with marked success. (c) Not absolutely.

76. (a) In metrical geometry models are used altogether for illustration. (b) Our time being limited, we spend little on original exercises, but with fine success. (c) Yes. The student should be required to carefully write each demonstration upon the board.

77. (a) In solid geometry all the principal figures are thus illustrated. (b) To a considerable extent in plane geometry and with excellent success. (c) Yes. More original work and less memorizing of demonstrations.

78. (a) Very little. (b) To a very considerable extent and with marked success. (c) No. More attention should be given to original work.

79. (a) To no great extent. (b) Original exercises are given as optional work and a few students are very successful in them. (c) Indifferent, provided they are given clearly and concisely.

80. (a) I use them very frequently. (b) Original exercises form a part of nearly every lesson. With a few exceptions the results are excellent, or at least satisfactory. (c) Yes. More original work.

(a) *To what extent are models used in geometry?* (b) *To what extent and with what success original exercises?* (c) *Do you favor memorizing verbatim the theorems (not the demonstrations) in geometry? What reforms are needed in teaching the same?*—Continued.

103. (a) None. (b) In geometry, with fair success; in practical surveying, leveling, etc. (c) Yes. As a rule, not allowing any lettering on board, etc.

104. (a) None. (b) None. (c) No.

106. (a) To a very limited extent. (b) To the extent which the time will permit, and with increasing degree of success. (c) I do not. I think reform needed in regard to grasping the truth, and giving it in good language, of the pupil's selection.

107. (a) Very little. (b) Slight extent. (c) No. More original work.

108. (a) Small. (c) Yes.

109. (a) Very little. (b) Considerable, with fair success. (c) No. Incorporation of some treatment of modern geometry.

110. (a) To a considerable extent in teaching solid geometry and spherical geometry. (b) Original exercises constitute half of the work, and with satisfactory success. (c) Yes. Require more solutions of practical problems; this tests the ability of the student and teaches him to walk alone.

111. (a) None. (b) We use few. (c) It is not material with us.

112. (a) Only to a limited extent in illustrating some of the properties of planes and solids. (b) To a great extent, and with satisfactory results. (c) I do. It is necessary that the student should know what he is required to demonstrate. Theory and practice should go hand in hand.

113. (a) They are used for every demonstration in solid geometry. (c) No.

114. (a) Very little. (b) It has not seemed profitable to spend much time on original work in geometry, which is a study of the Freshman year. (c) No.

115. (b) A great number of original exercises are given with complete success. (c) I do not favor memorizing anything except such principles as are needed in after work. For purposes of illustration we have a full set of models of solid and descriptive geometry. (b) Original exercises are given as regular and extra work to all classes. (c) Yes. The elementary principles of logic should be explained in connection with elementary geometry. (Tutor Fiske.)

116. (a) None. (b) Increasing number from year to year. Successful with first third of the class.

117. (a) Students make models in solid geometry. (b) With excellent results and to a large extent in geometry and trigonometry. (c) Yes. Throw students more on their own resources.

118. (a) Merely in explaining and illustrating. (b) They are required more or less throughout the course, especially in geometry. (c) Yes.

119. (a) We use the globe and the usual geometrical solids. (b) Original exercises are frequently given; success is very fair. (c) Yes.

120. (a) None are used in plane geometry. We have twenty-six fine models of warped and single-curved surfaces for use in descriptive geometry. (b) Original exercises are given out at each recitation, with great success as regards the development of mathematical knowledge. (c) No. With each lesson the student should have several original exercises involving the principles, to solve or demonstrate.

121. (a) Always in the teaching of geometry of space, when I find it helpful. (b) Continually given as *voluntary* text-work, excusing the student from formal examination in proportion to her success in it. (c) No. The abolition of *indirect* proof, and the use of symbolic notation, with special attention to *form*.

122. (a) In solid geometry. (b) To a limited extent. (c) Yes. More frequent *direct* application to problems in which dimensions are to be found.

123. (a) To a moderate extent. (b) To a considerable extent and with as good success as can be expected. (c) Yes. More frequent tests on original theorems and problems.

(a) *To what extent are models used in geometry?* (b) *To what extent and with what success original exercises?* (c) *Do you favor memorising verbatim the theorems (not the demonstrations) in geometry? What reforms are needed in teaching the same?*—Continued.

124. (a) The students make models of the regular polyhedrons. (b) Large numbers given in each class; this is one of our chief methods of drill and training; it is the only way in which fundamental principles can be so thoroughly ingrained in the mental make-up of a student that he is no longer conscious of an effort of memory in his knowledge. (c) Yes, to encourage exact expressions and as a tribute to order which is the soul of geometrical reasoning.

125. (a) Very little at present; hope to use them extensively. (b) To as large an extent as possible. With good success from the majority of students. (c) I do not. (1) Better trained teachers; (2) more thinking and less memorising; (3) use of thoroughly good text-books, like Byerly's Chauvenet; (4) emphasis of logic side; (5) generalization and summing up of truths proved, etc.

126. (a) No geometry taught excepting descriptive geometry. Students construct their own models. (b) Original exercises in almost daily use. (c) Yes. Demonstration of theorems without letters or figures.

127. (a) We have a set of "geometrical solids," which we use on occasion. (b) Such exercises are often required, and they are valuable—increasing the interest and testing the student's knowledge.

128. (a) Not largely, but so far as the students seem to need them. (b) Very largely and with good success. (c) A clean-cut, accurate statement, whether verbatim or not. Teacher to make sure of actual mastery of principles—no memory work; much use of original exercises.

129. (a) So far as is necessary for the pupil to get a clear conception of the geometrical concept. (b) In the preparatory course for admission to Freshman class, limited. In Freshman used to large extent. (c) Yes.

130. (a) Models of solids are used in solid geometry. (b) A good deal of use is made of them. Success good with best students. (c) No. More time should be given to leading the student to discover theorems for himself.

131. (a) Not very much. (b) As much as possible and with gratifying results. (c) No. More original exercises.

132. (a) Geometry is finished before entrance, except descriptive geometry, in which we use no models.

133. (a) To a limited extent with sphere and regular polyhedrons. (b) The original work in Wentworth's Geometry, with fair success. (c) Yes.

134. (a) In solid geometry. (b) Exercises and constructions on each book, and with good success. (c) No. Something like Wentworth's system of demonstrating propositions.

135. (a) None except sphere and cone. (b) At least one original exercise is given as a part of each lesson. Great success. (c) No. Students should be taught to master new processes or methods of proof rather than individual theorems; so come to look on theorems and proofs as illustrations of processes or methods of investigation.

136. (a) Not at all. (b) Very little, in obligatory mathematics; and in regular course there is hardly any pure geometry; but when there is any, such exercises are helpful. (c) Only in elementary work, and even in that the attendant dangers are great.

137. (a) To a slight extent only. (b) Limited extent, but with good success. (c) Yes.

138. (a) To a limited extent. (b) They are much used and with good results. (c) No.

139. (a) Very slight. (b) About fifty original exercises are given and are well done. (c) Yes.

140. (a) Slightly. (b) Considerably, with success. (c) No.

1) *To what extent are models used in geometry? (b) To what extent and with what success original exercises? (c) Do you favor memorizing verbatim the theorems (not the demonstrations) in geometry? What reforms are needed in teaching the same?—Continued.*

141. (a) Small. (b) Considerable extent and with commendable success. (c) Yes.

142. (b) With good success, as a rule. (c) Yes.

143. (a) Our models are such as we make ourselves. We illustrate, so far as possible, in solid and descriptive geometry. (b) All that I can have time for and can get the students to solve; great success with the few, little with the mass. (c) No; but I require a clear statement in somebody's words. More original work should be given; the student should be taught to depend upon himself more, and less upon book or teacher, to think, to originate, not memorize, not absorb.

144. (a) Not at all, except for young pupils. (b) Daily use and with good success. (c) Yes. Young pupils should be drilled in practical exercises, with use of instruments.

145. (a) Have been used but little. (b) Constantly and successfully. (c) No. *An earlier start, with main attention, at first, to training observation. Greater freedom from formalism.*

146. (a) Whenever possible. (b) Limited. (c) Yes.

147. (a) I make considerable use of models, especially in solid geometry. (b) Original exercises are required at a few places (two or three lessons). Good success. (c) Yes; yet I do not insist on keeping every word, provided the sense is kept.

148. (a) We do not use models. (b) We lay great stress on original exercises. When properly selected they are of the utmost service. (c) No. A clearer comprehension of the definitions; a more frequent enumeration of facts already proved; a more explicit enumeration of facts to be established in demonstrating any particular theorem.

149. (a) In a very limited degree. (b) For the past few years I have used them freely with gratifying success. (c) No.

150. (a) To a limited extent. (c) No.

151. (b) The study of geometry would fall far short of its object if original work were not required. I devote one recitation hour each week to it, and I am pleased with the results. I judge of the mental development by the original work done by pupils. (c) Yes. The facts of geometry must come first, concrete object lessons; can't reason about that concerning which we know little or nothing.

152. (a) But little, except in descriptive geometry. (b) Much time is given to solution of problems, both from text-book and from other sources. (c) Yes.

153. (a) Largely, especially in solid geometry. (b) Continually and copiously and with great success. (c) No. *The rejection of the words "direction" and "distance" from elementary geometry.*

154. (a) Largely, especially in conic sections and descriptive geometry. (b) Weekly exercises and with very satisfactory results. (c) No.

155. (a) To a limited extent. I expect to use models to a greater extent in the future. (b) Original exercises are greatly used. I value them very highly, and I am much pleased with the results I have obtained by using them in all my classes. (c) I do not.

156. (a) None used. (b) Special prominence is given to the use of original exercises, with encouraging success. (c) Yes. Originality should be encouraged.

157. (a) They are used to a very limited extent, simply because the college is not supplied with them. (b) Frequent exercises are given with quite good success. (c) I do not; I think that a student should be required always to express his thoughts in his own language, if for no other reason than to acquire facility in expression.

(a) *To what extent are models used in geometry?* (b) *To what extent and with what success original exercises?* (c) *Do you favor memorizing verbatim the theorems (not the demonstrations) in geometry? What reforms are needed in teaching the same?*—Continued.

158. (a) To only a small extent. (b) Largely given, and, I think, with great success in promoting intellectual pluck and thoroughness of attainment. (c) Yes; and also to learn to state them in one's own words. Subject too large for space. I will say, however, that the schools should give more exercises for solution, and train the boys from the beginning in original solution.

159. (a) Models are used in conic sections and for surfaces of revolution in analytic geometry of three dimensions. (b) Special attention given to original exercises. A taste for such work is easily developed in every lover of mathematics. (c) No; would prefer that the student thoroughly understand the truth to be demonstrated and express same in his own language.

160. (a) Very extensively, especially in solid geometry. (b) Largely, and with decided success. (c) Yes. I would have it made more practical.

161. (a) None. (b) Original exercises are frequent and attended with encouraging success. (c) I do. Demonstrations should be less verbose, and expressed to a greater extent by algebraic symbols.

162. (a) Considerably. (b) With almost every lesson, and with much success. (c) To some extent.

163. (a) Used to illustrate definitions. (b) We devote some time to them now; shall devote more; excellent success. (c) I do. Greater care that the pupils understand the reasons for every statement.

164. (a) Models used but little in first presenting the subject. (b) Original exercises given throughout the course, with good success. (c) No. Geometry should be taught as algebra and arithmetic by original work.

165. (a) Limited. (b) Largely, with great success. (c) Yes.

166. (a) We have none. (b) On each recitation, when there is time. (c) Yes. Less text-book and more originality.

167. (a) Very little. The attempt is made to lead the student to form his magnitudes in space, and without even a drawing, if possible. (b) To a very considerable extent, especially in test-work; and with excellent success in about one-half the cases. (c) No; but I would insist on concise and accurate statement. (1) Less bondage to text-book. (2) Encouraging original demonstrations. (3) Clearer distinction between leading steps of proof and details.

168. (a) Only slightly, because we are not able to afford them. (b) They are used as much as time will permit, and with good success. (c) No. Less time given to theorem-demonstration and more to original exercises, with the proper change in text books.

*Is elementary geometry preceded or accompanied by drawing?*

"Preceded": 21, 22, 23, 49, 51, 53, 55, 58, 62, 73, 76, 82, 90, 92, 94, 102, 103, 111, 112, 114, 139, 147.

"Accompanied": 5, 10, 12, 13, 14, 20, 21, 25, 27, 28, 30, 33, 34, 41, 42, 43, 44, 46, 54, 56, 57, 59, 60, 61, 66, 70, 71, 74, 94, 96, 97, 99, 101, 105, 106, 122, 127, 134, 135, 137, 138, 140, 142, 150, 153, 154, 157, 159, 164, 165, 166.

"Both preceded and accompanied": 4, 9, 11, 69, 85, 87, 88, 107, 111, 119, 124, 146, 160, 161.

"Neither preceded nor accompanied": 1—except engineering students; 15, 16, 17, 19, 31, 32, 34, 35, 37, 38—45, 63, 77—except in industrial course; 81, 91, 93, 108, 117, 109, 115, 116, 117, 120, 125, 128, 129—except in scientific course; 130, 131, 143, 150, 155, 156, 167, 168.

"Yes; either preceded or accompanied": 23, 26, 123, 145, 163.

*State time of your special preparation for teaching mathematics, number of hours you teach per week, and what other subjects you teach.*

1. Teach twenty hours per week; teach no other subjects.
3. About ten years before entering the University of Alabama, where I spent five years; physics and astronomy.
4. I teach twenty-five hours a week, and during five months in the year give about six hours a week to special work in surveying; I teach no other subjects.
5. Six and a half hours per day in the entire school, with one-half hour recitation for classes at different times.
6. From 1880 to 1886; nine hours; geology, astronomy, elocution.
8. Two years; thirty-five hours per week; book-keeping, six hours per week.
9. I teach only mathematics, and give five lessons of one and one-fourth hours each per week.
10. Four years; seventeen hours per week; no other subjects save military science and tactics.
11. Five years' study at the Cincinnati Observatory after graduating from college. At present I teach thirty recitation hours (forty-five minutes each) a week. Astronomy (popular).
12. It has been my specialty for eight years; twenty hours per week; none.
13. Pure mathematics is taught twenty hours per week.
14. Teach mathematics three and four hours per week; my chief subject is chemistry, while mathematics is a secondary subject here.
15. I have taught mathematics since graduating from college (1870). I teach from eight to twelve hours per week. Astronomy is also in my charge.
16. I teach from twenty to thirty hours per week, and teach no other subject.
17. Five years; twenty hours per week; none.
18. The classes of mathematics, except the first class, are taught by the professors of the regular classical course. Each professor teaches only one class of mathematics.
19. Ten to fifteen hours per week, mental science and chemistry, etc. (Professor Gordon). Preparation has nearly all been made since I began and while teaching; ten hours; Latin (Professor Draper).
20. I teach mathematics twenty hours per week. I teach no other subjects.
21. Mathematics was my specialty in college two years; teach it fifteen hours per week. I teach no other subjects.
22. About three hours per diem devoted to teaching. Teach, besides, chemistry and elocution.
23. I teach twenty hours per week, and also military science and tactics.
25. Three hours per day. I teach nothing but mathematics.
27. I teach only pure mathematics.
28. Thirty; teach no other subject.
29. Fifteen hours a week; physics five hours a week for six months; astronomy five hours a week for four months; psychology five hours a week for three months.
30. Sixteen to twenty hours. I teach philosophy, astronomy, logic, moral philosophy.
32. I give fifteen to twenty hours of instruction, and teach several natural sciences, besides some German.
33. One year and a half; twenty hours; no other subjects.
34. Several graduate courses at Princeton College, and private study. I teach from eleven to fifteen hours per week. Am also engaged in teaching astronomy.

*State time of your special preparation for teaching mathematics, number of hours you teach per week, and what other subjects you teach—Continued.*

35. Have taught and have been a student in the higher mathematics the past twenty years; fifteen hours per week; not any. (Professor Shattuck.) Algebra, five hours per week for two terms; geometry, same; natural philosophy, physiology, botany, English, rhetoric, Latin, Greek. (Regent Peabody.)

37. One year; twelve hours per week, besides teaching some in preparatory department.

39. I teach mathematics and astronomy about twenty hours per week; no other subjects.

39. Fifteen hours; no other subjects.

40. Teach about twenty hours per week. I teach regularly no other subject and only the mathematics in the college department.

41. I spend from one to two hours per lesson on mathematical works, directly or remotely connected with the recitation. I teach twenty hours per week and only mathematics.

43. Teach twenty hours per week; teach no other subject except astronomy.

44. Eighteen hours per week; history and vocal music.

45. Everything pertaining to or suggested by the lesson is prepared. All lessons are five hours per week with one exception; geometry has four.

46. I teach mathematics and astronomy fifteen hours per week; assistant teaches mathematics fifteen hours per week also.

47. After graduating at Madison, spent four years in post-graduate study at Yale; fifteen to twenty hours; astronomy and political economy.

50. We have four teachers of mathematics, who spend about fifteen hours a week in their classes.

51. Am at it nearly all my time that can be secured from other work; first term, fifteen hours; second term, twenty hours.

52. Thirty hours per week; political economy.

53. All afternoon for preparation; twenty-five a week; none.

55. Have taught it for eighteen years, six years exclusively. Teach mathematics twenty hours per week; teach nothing else.

56. I took the two years' collegiate course required and took the post-graduate course, spending three months on special work in mathematics; fifteen hours; natural science.

57. Some class almost every hour in the day, averaging, perhaps, twenty-five hours per week.

58. Scarcely any two terms the same.

59. About three-fifths of my time is given to mathematics and about two-fifths to Latin and Greek.

60. Three years; twenty hours; political science, astronomy, and German.

61. Fifteen hours per week; mental philosophy and logic.

62. I teach mathematics fifteen hours per week and have some classes in Latin. My preparation is done each night before the work of the following day.

63. Six to ten hours; eighteen hours; Latin, physiology, physical geography, English literature.

64. One hour daily; twelve hours per week; astronomy, natural philosophy, chemistry, geology, mineralogy, drawing.

65. Four years at college, one in private work, and two at Johns Hopkins University. Twenty-four hours per week. Nothing else.

66. Four hours per week.

70. Mathematical course at Yale College together with four years subsequent study. Political economy and English literature.

71. Since completing the course in this college, three years ago, I have spent in private study a considerable portion of my time; five to ten hours per week; rhetoric and drawing.

*State time of your special preparation for teaching mathematics, number of hours you teach per week, and what other subjects you teach—Continued.*

72. Eight, six, or four hours per week, according to term, whether it be fall, winter, or spring. Lecture on art.

73. The only special preparation I employ is the light reading of new textbooks which come to hand. For over twenty years have had no difficulties in mathematical instruction. I also teach, as occasion calls, metaphysics, morals, political economy, history, literature, etc.

74. Teach on an average twelve hours per week.

76. Three years; about fifteen hours per week; physics and meteorology.

77. I teach twenty-five hours per week, five hours of which are devoted to industrial drawing.

80. Three years in which I did the four years' work in college mathematics, required and elective, together with outside special work in same subject. I teach five or six classes per day in mathematics. I have only astronomy, besides mathematics.

82. Harvard College, A. B., with electives in mathematics.

85. A four-years' course in both State Normal school and college; no other subject.

86. I teach mathematics about five to nine hours weekly, astronomy three to fifteen hours weekly; and, *this term*, am teaching algebra. In addition, I have certain duties connected with the observatory, and a requirement of the founder of my professorship, viz, I have to contribute to the advancement of astronomical science.

87. Two gentlemen here are occupied in teaching mathematics, exclusive of analytical mechanics and civil engineering; occupied in class-room eighteen or twenty hours.

89. Five hours per week and five hours for assistant; mining, surveying, mechanics.

90. Two years; twenty-two and one-half hours; no other subjects.

91. Several hours each day; twenty hours per week. (I only teach the higher branches.) My assistant teaches all up to and including analytic geometry, moral science, etc.

92. The mathematics of an ordinary college course and two summer vacations' study with the late Dr. Edward Olney, of Michigan University; thirteen and one-third hours per week; physics and astronomy.

93. Two years (1871-73) of post-graduate work, and fifteen years since as specialist; teach about seventeen hours per week; part of the work done by an assistant; astronomy.

94. Twelve and one-half hours; political economy.

95. I have calculus four times per week, mechanics six times, and thermodynamics (Clausius) three times.

97. Two years' private study, three years' study in Europe; fifteen or twenty; none.

98. Five hours' class-work per week for five years, full course.

99. Ten per week.

101. Eighteen hours per week; physics.

103. Preparation, four years' course at the United States Military Academy; average time, ten hours per week; arts and science of war and tactics.

104. Forty-nine years; fifteen hours per week; no other subject.

105. The professor of mathematics has not had special training, but has special aptitude in this direction. Has usually taught chemistry.

106. My teaching is limited to mathematics; fifteen hours per week.

107. Four years at Dartmouth College, and two years at the Thayer School of Civil Engineering; about ten hours per week; mechanics, astronomy, meteorology, surveying.



*State time of your special preparation for teaching mathematics, number of hours you teach per week, and what other subjects you teach—Continued.*

108. Twenty hours per week ; no other subject.
109. Graduated Ph. B. at the University of North Carolina, and spent one year studying mathematics at the Johns Hopkins University ; eight hours per week ; English four hours.
110. Time of teaching varies from eighteen to twenty one hours per week.
112. Teaching hours, sixteen per week ; I teach no other subjects.
113. Generally prepare in one-half hour ; teach two hours ; Latin and Greek one hour each.
114. Five years ; fourteen hours per week ; no other subjects.
115. Our professors teach but one subject.
116. My college course, supplemented by three years' study in Germany ; I teach ten hours per week ; no other subject.
117. Have been teaching mathematics and science for fifteen years. At present most is done here by our instructor.
119. From ten to sixteen hours per week ; I teach nothing but mathematics.
120. I devote eighteen hours per week to teaching ; I do not instruct in any other subject.
121. Mathematics and physics, also lectures on general astronomy and some on physical geography.
123. Average eighteen ; none.
124. Graduate of the University of Virginia, with degrees of bachelor of science, civil engineer, mining engineer ; two years a student of mathematics in Cambridge University, England, and fourteen months at Göttingen, Germany ; seventeen hours per week (mathematics and astronomy). Assistant Prof. C. E. Kilbourne, graduate of United States Military Academy, teaches ten hours per week, and Assistant Prof. G. W. McCoard (Botham College, W. Va.) teaches eighteen hours per week.
125. One and one-half years in university, besides work done privately. Mathematics, twelve hours per week ; two hours in civil engineering and astronomy.
127. I teach mathematics from fifteen to twenty hours per week, and French from five to ten hours.
128. Aside from regular college and private work, a year's partial work at Harvard. Teach fifteen hours a week. No other subject, except Bible, one hour a week.
129. From ten to fifteen hours ; astronomy, surveying, and bridge construction.
130. Four years, seventeen to eighteen hours ; astronomy and elementary mechanics are included in the seventeen or eighteen hours.
131. Post-graduate student two years at Massachusetts Agricultural College and Johns Hopkins University. Teach twelve to sixteen hours per week. Astronomy also.
133. No special training aside from a regular college course and private study ; ten hours ; mechanics, physics, astronomy.
134. Teach three hours each day ; surveying and mechanics.
135. One year, after graduation from college ; eleven hours per week ; astronomy.
136. Graduated with honors at Girton College, Cambridge, 1880 ; four years' subsequent residence and attendance at Professor Cayley's lectures ; ten or eleven hours per week ; no other subject.
139. Amount of time occupied in teaching is regularly eighteen hours, often increased by extra work. I teach no other subject.
140. Prof. Isaac Sharpless, L. B. Harvard ; seven hours ; none. Prof. Frank Morley, A. M. and eighth wrangler of Cambridge ; fourteen hours ; none.

*State time of your special preparation for teaching mathematics, number of hours you teach per week, and what other subjects you teach—Continued.*

142. Usual college course; twelve hours per week; Latin.

143. A college course and all the mathematics, both regular and extra, I could crowd into it. I teach now thirteen to fifteen hours per week. No other subject.

144. Algebra, five times; geometry, five; trigonometry, three; analytical geometry, three; calculus, three; analytical mechanics, three; trigonometry and surveying by an assistant.

145. Five years; thirteen hours per week; no other subject.

147. I have never taken a *special* course in mathematics, but have studied advanced works to some extent. I teach mathematics four hours a day. I have in charge vocal music, which takes forty minutes a day.

148. I teach (personally) twenty to thirty hours a week. About one-fourth of this time is occupied with mathematics, the other three-fourths with mechanics and civil engineering.

149. I teach no other subjects. I teach twenty hours per week.

150. Twenty-five hours per week; none.

151. No special preparation; twenty hours per week. I teach no other studies.

153. I devoted twelve years to my special preparation for teaching mathematics.

154. I am a student of mathematics; have charge of the department, but only teach the higher classes.

155. I first took a college course in mathematics. After this I spent several years in post-graduate work. I teach eighteen hours per week, and I teach no other subjects.

156. About seventeen hours per week; no other subject.

157. I have a course in civil engineering. I also have charge of a commercial course.

158. Number of hours given above one and a half at thirteen per week. But this does not include office hours of myself and assistant for meeting students and giving explanation. My assistant does not teach, but simply keeps office hours for consultation and solution and explanation of difficulties in lectures or assigned work. I will add that the under-graduate course in pure mathematics is the most extensive and thorough one given in any university in the United States.

159. With assistant, twenty-four hours per week; modern languages (French and German).

160. Twenty hours per week; civil engineering.

161. I teach mathematics four hours each day, and also teach physics and chemistry.

163. Sixteen hours per week; eighteen hours; French, Latin, history.

164. About twenty-five hours per week.

166. We give each class one hour each day. Any subject in the course.

165. Twenty years' experience in the mathematical class-room; about ten hours per week in mathematics, and five hours per week in physics.

162. The number of hours of teaching varies from five to twenty per week. College course and then three years at Yale; physics and astronomy.

## (b) NORMAL SCHOOLS.

|     | Name of institution.                                        | Location.             | Name of person reporting. | Title or position of person reporting.                     |
|-----|-------------------------------------------------------------|-----------------------|---------------------------|------------------------------------------------------------|
| 169 | State Normal School.....                                    | Jacksonville, Ala...  | C. B. Gibson.....         | President.                                                 |
| 170 | State Normal School.....                                    | Flommo, Ala.....      | J. K. Powers.....         | Do.                                                        |
| 171 | Normal School.....                                          | Tuskegee, Ala.....    | Maria A. Benson...        | Instructor in mathematics.                                 |
| 172 | Branch Normal School of the Arkansas Industrial University. | Pine Bluff, Ark.....  | J. C. Corbin.....         | Principal.                                                 |
| 173 | State Normal School.....                                    | San José, Cal.....    | R. S. Holway.....         | Teacher in normal school.                                  |
| 174 | State Normal School.....                                    | Madison, Dak.....     | William F. Gorrie...      | President.                                                 |
| 175 | Washington Normal School.                                   | Washington, D. C....  | E. S. Atkinson....        | Principal.                                                 |
| 176 | Southern Illinois Normal University.                        | Carbondale, Ill.....  | G. V. Buchanan....        | Teacher of mathematics.                                    |
| 177 | Tri-State Normal College.                                   | Angola, Ind.....      | L. M. Sniff.....          | President.                                                 |
| 178 | State Normal School.....                                    | Terre Haute, Ind..... | Nathan Newby.....         | Professor of mathematics.                                  |
| 179 | State Normal School.....                                    | Cedar Falls, Iowa...  | D. S. Wright.....         | Do.                                                        |
| 180 | State Normal School.....                                    | Emporia, Kans.....    | M. A. Bailey.....         | Do.                                                        |
| 181 | State Normal School.....                                    | Gorham, Me.....       | W. J. Corbett.....        | Principal.                                                 |
| 182 | State Normal School.....                                    | Baltimore, Md.....    | George L. Smith....       | Professor of mathematics.                                  |
| 183 | State Normal School.....                                    | Westfield, Mass....   | J. C. Greenough....       | Principal.                                                 |
| 184 | State Normal School.....                                    | Worcester, Mass....   | E. H. Russell.....        | Do.                                                        |
| 185 | Iuka Normal Institute....                                   | Iuka, Miss.....       | E. L. Sherwood....        | Professor of natural science and mathematics.              |
| 186 | State Normal School.....                                    | Warrensburg, Mo....   | George H. Howe....        | Professor of mathematics.                                  |
| 187 | North-Western Normal School.                                | Stanberry, Mo.....    | A. Moore.....             | Principal.                                                 |
| 188 | State Normal School.....                                    | Kirksville, Mo.....   | J. I. Nelson.....         | Professor of mathematics.                                  |
| 189 | Fremont Normal School..                                     | Fremont, Nebr.....    | W. H. Clemmons....        | President.                                                 |
| 190 | Normal College of New York.                                 | New York, N. Y.....   | J. A. Gilm.....           | Professor of mathematics and physics.                      |
| 191 | State Normal and Training School.                           | Geneese, N. Y.....    | R. A. Waterbury....       | Professor of higher mathematics and methods in arithmetic. |
| 192 | State Normal and Training School.                           | Cortland, N. Y.....   | D. E. Smith.....          | Professor of mathematics.                                  |
| 193 | State Normal School.....                                    | Oswego, N. Y.....     | W. G. Kappleys....        | Teacher of mathematics.                                    |
| 194 | State Normal and Training School.                           | New Paltz, N. Y....   | F. S. Capen.....          | Principal.                                                 |
| 195 | State Normal School.....                                    | Albany, N. Y.....     | E. P. Waterbury....       | Do.                                                        |
| 196 | State Normal School.....                                    | Buffalo, N. Y.....    | J. M. Cassidy.....        | Do.                                                        |
| 197 | State Colored Normal School.                                | Plymouth, N. C....    | H. C. Crosby.....         | Do.                                                        |
| 198 | Normal Training School.                                     | Cleveland, Ohio....   | Ellen E. Reveley....      | Do.                                                        |
| 199 | North-Western Normal and Collegiate Institute.              | Wauson, Ohio.....     | J. H. Diebel.....         | Instructor in mathematics.                                 |
| 200 | State Normal School.....                                    | Ashtland, Oregon...   | J. S. Sweet.....          | President.                                                 |
| 201 | Drain Academy and State Normal.                             | Drain, Oregon.....    | W. C. Hawley....          | Do.                                                        |
| 202 | State Normal School.....                                    | Blacksburg, Pa....    | G. E. Wilbur.....         | Professor of higher mathematics and history.               |
| 203 | State Normal School.....                                    | Clarion, Pa.....      | J. H. Apple.....          | Professor of mathematics.                                  |
| 204 | Philadelphia Normal School.                                 | Philadelphia, Pa....  | G. W. Fetter.....         | Principal.                                                 |
| 205 | Chambers and Valley State Normal School.                    | Shippensburg, Pa....  | E. H. Bugbee.....         | Teacher of mathematics.                                    |

(b) NORMAL SCHOOLS—Continued.

|     | Name of institution.         | Location.            | Name of person reporting. | Title or position of person reporting. |
|-----|------------------------------|----------------------|---------------------------|----------------------------------------|
| 206 | State Normal School.....     | West Chester, Pa...  | D. M. Samsenig....        | Professor of mathematics.              |
| 207 | Central State Normal School. | Lock Haven, Pa....   | O. W. Kitchell....        | Instructor in mathematics.             |
| 208 | Richmond Normal School.      | Richmond, Va.....    | S. T. Beach.....          | Principal.                             |
| 209 | State Normal School.....     | Fairmont, W. Va....  | C. A. Sipe.....           | Id.                                    |
| 210 | State Normal School.....     | Farmville, Va.....   | Celestia S. Parish.       | Teacher of mathematics.                |
| 211 | State Normal School.....     | Johnson, Vt.....     | A. H. Campbell...         | Principal.                             |
| 212 | State Normal School.....     | Oshkosh, Wis.....    | E. F. Webster.....        | Teacher of mathematics.                |
| 213 | State Normal School.....     | River Falls, Wis.... | .....                     | .....                                  |

*State time of your special preparation for teaching mathematics, number of hours you teach per week, and what other subjects you teach.*

169. Four years; twenty hours; physics, chemistry, and astronomy.
170. Two years; ten hours; no other subject.
171. Twenty hours; reading.
172. I personally teach, at present, one class each in algebra, arithmetic, and geometry, for five days in the week, one in natural philosophy
173. Twenty hours; no other subject.
174. Algebra five hours; geometry, Latin, zoölogy, history of education.
176. Regular course in university; twenty-five hours; no other subject.
177. Twenty hours; no other subject.
179. Twenty hours; no other subject.
180. Twenty years; twenty-four hours; no other subject.
182. Drawing and physics.
183. The teacher of mathematics has ten hours; physiology.
185. Two years; six hours; natural science, history, rhetoric, and book-keeping.
186. Six classes per day, forty minutes each, five days per week; no other subject.
188. Five hours per day; astronomy one hour per day.
189. Fifteen hours.
190. Twelve hours; chemistry, physics.
191. Have taught mathematics almost exclusively for seventeen years, and principally for twenty-five years; thirty hours.
192. Election of all mathematics I could get in college course; eighteen and three-fourths hours; class on school law.
193. Graduate of Cornell; twenty-five hours; none.
195. Two years; twenty hours; none.
196. Mathematical course at Dartmouth; fifteen hours; astronomy.
197. Ten hours; physiology, history, moral science, and English literature.
198. Teachers of mathematics not specialists.
199. Six hours per day; no other subject.
200. Twelve hours; book-keeping, philosophy, psychology, art of school management.
201. Seven hours per week.
202. Four years; twenty-five periods, forty-five minutes each, per week; civil government.
203. Classical college course; twenty-five hours; no other subject.
204. Theory and practice of teaching and school government.
205. Twenty-two hours; no other subject.

*State time of your special preparation for teaching mathematics, number of hours you teach per week, and what other subjects you teach—Continued.*

206. Graduate of both elementary and scientific courses of Millersville State Normal School, Pennsylvania; have taught for twenty years scarcely anything but mathematics in three of the normal schools in Pennsylvania. Am author of *Numbers Symbolized*, an elementary algebra, and have in press *Numbers Universalized*; thirty hours.

207. Twenty hours; Latin.

208. Algebra, three hours; physics, physical geography, rhetoric, Latin, etc.

210. Private study at intervals for four years; twenty-five hours; no other subject.

211. Usual course in academy, normal school, and college.

212. None, except that spent in my regular course in the normal school; fifteen hours; no other branches.

*Are students entering your institution thorough in the mathematics required for admission?*

Of the forty-five reports received from normal schools three or four give no reply to this; all others answer no, excepting the institutions numbered 175, "generally so;" 176, "reasonably so;" 180, "fairly so;" 190 and 194, "yes."

*What are the requirements in mathematics for admission?*

Number 169 reports, arithmetic and elementary algebra; 190, arithmetic and a little geometry; all others require only arithmetic, generally not the whole of it, but through fractions and the simpler cases of percentage. Number 197 says, "fundamental rules of arithmetic;" 204 says, "fractions and percentage." A few institutions admit all who apply, without examination in mathematics.

*Is the metric system taught?*

All answered in the affirmative, excepting those bearing the numbers 171, 185, 190, 208.

*Which is taught first, algebra or geometry?*

All answered "algebra," excepting numbers 181, 183, 190, 210, 211.

Numbers 181, 183, 210 take up geometry first.

Numbers 181, 211 teach both together.

*How far do you proceed in the one before taking up the other?*

The following carry students first through a full course of elementary algebra: 169, 170, 174, 180, 184, 185, 189, 201, 206, 208, 209.

The following, through quadratics: 173, 178, 197.

The following, to rationals: 181, 183, 212.

The following, to quadratics: 182, 195, 200, 204.

The following, through fractions: 188, 207.

Institution 181 finishes plane geometry before taking up algebra: 183 gives no term of geometry before algebra: 210 observes the following order: (1) A course in form; (2) Rudiments of algebra; (3) Simple geometric theorems and constructions; (4) More difficult algebra; (5) More difficult geometry.

*Are percentage and its applications taught before the rudiments of algebra or after?*

All who answered said before, except the following—192, 194, 210, that said "after;" though some of the simplest parts of percentage were taught before; 184 and 188 said that both were taught together.

The usual course in the normal schools generally embraces a somewhat thorough study of arithmetic, the study of algebra and geometry, and usually a little trigonometry.

(c) ACADEMIES, INSTITUTES, AND HIGH SCHOOLS.

|     | Name of institution.                     | Location.                          | Name of person reporting.     | Title or position of person reporting.   |
|-----|------------------------------------------|------------------------------------|-------------------------------|------------------------------------------|
| 214 | Toroll's Institute for Boys              | Mobile, Ala. ....                  | A. Toroll .....               | Principal.                               |
| 215 | Public High School .....                 | Birmingham, Ala. ...               | J. H. Phillips .....          | Superintendent of schools.               |
| 216 | University High School ..                | Tuscaloosa, Ala. ....              | W. H. Verner .....            | Principal.                               |
| 217 | Marianna Institute .....                 | Marianna, Ark. ....                | F. A. Futrell .....           |                                          |
| 218 | Rogers Academy .....                     | Rogers, Ark. ....                  | J. W. Scroggs .....           | Principal.                               |
| 219 | Hopkins Academy .....                    | Oakland, Cal. ....                 | Geo. C. Edwards ..            | Teacher of mathematics.                  |
| 220 | St. Matthew's Hall .....                 | San Mateo, Cal. ....               | H. D. Robinson ...            | Tutor of mathematics.                    |
| 221 | Boys' High School .....                  | San Francisco, Cal..               | W. N. Bush .....              | Head-teacher of mathematical department. |
| 222 | Los Angeles High School.                 | Los Angeles, Cal. ....             | F. A. Dunham ....             | Assistant teacher.                       |
| 223 | Girls' High School .....                 | San Francisco, Cal..               | Fidelia Jewett....            | Head of department of mathematics.       |
| 224 | Oakland High School .....                | Oakland, Cal. ....                 | S. A. Chambers ...            | Teacher of mathematics.                  |
| 225 | High School .....                        | Colorado Springs, Colo.            | Harriet Winfield ..           | Teacher of mathematics and science.      |
| 226 | School for Boys .....                    | Stamford, Conn. ....               | H. M. King .....              | Principal.                               |
| 227 | Connecticut Literary Institution.        | Scitield, Conn. ....               | M. H. Smith .....             | Do.                                      |
| 228 | Public High School .....                 | New Britain, Conn..                | John H. Peck .....            | Do.                                      |
| 229 | Sioux Falls High School ..               | Sioux Falls, Dak. ....             | Anna Emerson ...              | Assistant high school teacher.           |
| 230 | Washington High School.                  | Washington, D. C. ...              | Charlotte Smith ..            | Teacher of mathematics.                  |
| 231 | Columbian College Preparatory School.    | .....do .....                      | H. L. Hodgkins ...            | Instructor in mathematics.               |
| 232 | Sparta Academy .....                     | Sparta, Ga. ....                   | C. E. Little .....            | Principal.                               |
| 233 | Academy of Richmond County.              | Augusta, Ga. ....                  | C. H. Withrow ....            | Do.                                      |
| 234 | Allen Academy .....                      | Chicago, Ill. ....                 | I. W. Allen .....             | President.                               |
| 235 | Public High School .....                 | Hyde Park, Ill. ....               | W. H. Beny .....              | Principal.                               |
| 236 | North Division High School.              | Chicago, Ill. ....                 | O. I. Westcott .....          | Do.                                      |
| 237 | West Division High School.               | .....do .....                      | G. P. Welles .....            | Do.                                      |
| 238 | Peoria High School .....                 | Peoria, Ill. ....                  | G. E. Knepper ....            | Do.                                      |
| 239 | Joliet High School .....                 | Joliet, Ill. ....                  | O. L. Manchester ..           | Do.                                      |
| 240 | South Division High School.              | Chicago, Ill. ....                 | J. Slocum .....               | Do.                                      |
| 241 | Jennings Seminary .....                  | Aurora, Ill. ....                  | J. E. Adams .....             | Science and higher mathematics.          |
| 242 | High School .....                        | Urbana, Ill. ....                  | J. W. Hays .....              | Superintendent of schools.               |
| 243 | Roanoke Classical Seminary.              | Roanoke, Ind. ....                 | D. N. Howe .....              | Principal.                               |
| 244 | Central Grammar High School.             | Fort Wayne, Ind. ...               | Chester L. Lane ..            | Do.                                      |
| 245 | Public High School .....                 | Crawfordsville, Ind.               | T. H. Dunn .....              | Superintendent of city schools.          |
| 246 | Indianapolis High School.                | Indianapolis, Ind. ...             | W. W. Grant .....             | Principal.                               |
| 247 | Union High School .....                  | Westfield, Ind. ....               | M. E. Cox .....               | Do.                                      |
| 248 | Indianapolis Classical School for Boys.  | Indianapolis, Ind. ...             | T. L. Sewall .....            | Do.                                      |
| 249 | Indianapolis Classical School for Girls. | .....do .....                      | T. L. Sewall, Mary W. Sewall. | Principals.                              |
| 250 | New Hope Female Academy.                 | Oak Lodge, Choctaw Nation, Ind. T. | A. Griffith .....             | Superintendent.                          |

## (c) ACADEMIES, INSTITUTES, AND HIGH SCHOOLS—Continued.

|     | Name of institution.                           | Location.              | Name of person reporting. | Title or position of person reporting. |
|-----|------------------------------------------------|------------------------|---------------------------|----------------------------------------|
| 251 | High School.....                               | Davenport, Iowa....    | T. E. Stratton.....       | Principal.                             |
| 252 | High School.....                               | Des Moines, Iowa....   | J. F. Gowdy.....          | Teacher of mathematics.                |
| 253 | Iowa City Academy.....                         | Iowa City, Iowa....    | M. R. Tripp.....          | Do.                                    |
| 254 | High School.....                               | Burlington, Iowa....   | E. Poppe.....             | Principal.                             |
| 255 | High School.....                               | Davenport, Iowa....    | F. E. Stratton.....       | Do.                                    |
| 256 | High School.....                               | Topeka, Kans.....      | J. E. Williamson.....     | Do.                                    |
| 257 | High School.....                               | Ottawa, Kans.....      | G. I. Harvey.....         | Superintendent.                        |
| 258 | High School.....                               | Paducah, Ky.....       | A. H. Beale.....          | Do.                                    |
| 259 | New Orleans Seminary ..                        | New Orleans, La.....   | L. G. Atkinson.....       | President.                             |
| 260 | Girls' High School.....                        | do.....                | M. C. Cusack.....         | Department of mathematics.             |
| 261 | Madawaska Training School.                     | Augusta, Me.....       | Vetal Cye.....            |                                        |
| 262 | Franklin Female College.                       | Topsham, Me.....       | D. L. Smith.....          | Principal.                             |
| 263 | High School.....                               | Saco, Me.....          | L. M. Chadwick.....       | Assistant teacher.                     |
| 264 | High School.....                               | Bath, Me.....          | H. E. Cole.....           | Principal.                             |
| 265 | Fryeburg Academy.....                          | Fryeburg, Me.....      | M. E. Bussell.....        | Assistant.                             |
| 266 | High School.....                               | Portland, Me.....      | A. E. Chase.....          | Principal.                             |
| 267 | McDonogh School.....                           | McDonogh, Md.....      | D. C. Lyle.....           |                                        |
| 268 | Washington County Male High School.            | Hagerstown, Md.....    | G. C. Pearson.....        | Principal.                             |
| 269 | Centreville Academy and High School.           | Centreville, Md.....   | A. G. Harley.....         | Principal.                             |
| 270 | Friends' Academy.....                          | New Bedford, Mass..... | G. B. Dodge.....          | Assistant teacher.                     |
| 271 | Haverhill Training School                      | Haverhill, Mass.....   | C. A. Newton.....         | Principal.                             |
| 272 | Mount Hermon School ..                         | Mount Hermon, Mass.    | H. E. Sawyer.....         | Superintendent.                        |
| 273 | Cushing Academy.....                           | Ashburham, Mass.....   | F. D. Lane.....           | Instructor in mathematics and German.  |
| 274 | Prospect High School.....                      | Greenfield, Mass.....  | Ida F. Foster.....        | Teacher of science and mathematics.    |
| 275 | High School.....                               | New Bedford, Mass..... | R. G. Huling.....         | Principal.                             |
| 276 | Eaton School.....                              | Middleborough, Mass.   | A. A. Eaton.....          | Do.                                    |
| 277 | Powder Point School ..                         | Duxbury, Mass.....     | F. B. Knapp.....          | Do.                                    |
| 278 | Admiral Sir Isaac Coffin's Lancastrian School. | Nantucket, Mass.....   | E. B. Fox.....            | Do.                                    |
| 279 | Whitton Female Seminary.                       | Norton, Mass.....      | S. L. Dawes.....          | Teacher of mathematics.                |
| 280 | Lawrence Academy.....                          | Falmouth, Mass.....    | S. A. Holten.....         | Principal.                             |
| 281 | Smith Academy.....                             | Hatfield, Mass.....    | S. L. Cutler.....         | Do.                                    |
| 282 | Partridge Academy.....                         | Duxbury, Mass.....     | C. F. Jacobs.....         | Do.                                    |
| 283 | High School.....                               | Peabody, Mass.....     | C. A. Holbrook.....       | Do.                                    |
| 284 | High School.....                               | Salem, Mass.....       | A. L. Goodrich.....       | Master.                                |
| 285 | Hanover Academy.....                           | Hanover, Mass.....     | A. P. Averill.....        | Principal.                             |
| 286 | Lynn High School.....                          | Lynn, Mass.....        | William Fuller.....       | Teacher of mathematics.                |
| 287 | Bristol Academy.....                           | Taunton, Mass.....     | William F. Palmer.....    | Principal.                             |
| 288 | High School.....                               | Amherst, Mass.....     | S. A. Sherman.....        | Do.                                    |
| 289 | Nichols Academy.....                           | Dudley, Mass.....      | E. O. Clark.....          | Do.                                    |
| 290 | High School.....                               | Haverhill, Mass.....   | Clarence E. Kelley.....   | Do.                                    |
| 291 | High School.....                               | Fitchburg, Mass.....   | H. W. Kittredge.....      | Do.                                    |
| 292 | Sawin Academy and Dawson High School.          | Sherborn, Mass.....    | W. F. Gregory.....        | Do.                                    |

(c) ACADEMIES, INSTITUTES, AND HIGH SCHOOLS—Continued.

|     | Name of Institution.                  | Location.              | Name of person reporting. | Title or position of person reporting.            |
|-----|---------------------------------------|------------------------|---------------------------|---------------------------------------------------|
| 293 | Drury High School .....               | North Adams, Mass.     | Elizabeth H. Talcott.     | First assistant.                                  |
| 294 | Charlestown High School.              | Boston, Mass. ....     | J. O. Morris .....        | Head-master.                                      |
| 295 | Girls' High School.....               | do .....               | Adeline L. Sylvester.     | Assistant teachers.                               |
|     |                                       |                        | Emerette O. Patch.        |                                                   |
| 296 | Public Latin School .....             | do .....               | G. C. Emery .....         | Teacher of mathematics.                           |
| 297 | Cambridge Latin School..              | Cambridge, Mass. ...   | W. F. Bradbury...         | Head-master.                                      |
| 298 | West Roxbury High School              | Boston, Mass. ....     | G. C. Mann .....          | Principal.                                        |
| 299 | English and Classical High School.    | Worcester, Mass. ....  | A. S. Roe .....           | Do.                                               |
| 300 | High School .....                     | Ann Arbor, Mich. ...   | L. D. Wines .....         | Instructor in higher mathematics.                 |
| 301 | Michigan Military Academy.            | Orchard Lake, Mich.    | W. H. Butts .....         | Principal.                                        |
| 302 | High School .....                     | Menominee, Mich. ...   | Jesse Hubbard ...         | Superintendent of city schools.                   |
| 303 | High School .....                     | Ypsilanti, Mich. ....  | R. W. Putnam ....         | Superintendent of schools.                        |
| 304 | High School .....                     | Grand Rapids, Mich.    | W. A. Greeson ....        | Principal.                                        |
| 305 | Michigan Female Seminary.             | Kalamazoo, Mich. ...   | Isabella G. French        | Do.                                               |
| 306 | Shattuck School .....                 | Faribault, Minn. ....  | Wm. W. Champion.          |                                                   |
| 307 | Public High School .....              | St. Cloud, Minn. ....  | C. C. Schmidt .....       | Superintendent.                                   |
| 308 | Augsburg Seminary .....               | Minneapolis, Minn. ..  | Wilhelm Fetter-<br>sen.   | Instructor.                                       |
| 309 | Minneapolis Academy .....             | do .....               | E. D. Holmes .....        | Principal.                                        |
| 310 | Public High School .....              | Vicksburg, Miss. ....  | E. W. Wright ....         | Superintendent of public schools.                 |
| 311 | Smith Academy, Washington University. | St. Louis, Mo. ....    | E. R. Offutt .....        | Teacher of mathematics.                           |
| 312 | St. Joseph High School ...            | St. Joseph, Mo. ....   | C. S. Thacher .....       | Do.                                               |
| 313 | Lincoln High School .....             | Lincoln, Nebr. ....    | S. P. Barrett .....       | Principal.                                        |
| 314 | Robinson Female Seminary.             | Exeter, N. H. ....     | G. N. Cross .....         | Do.                                               |
| 315 | Simonds Free High School              | Warner, N. H. ....     | E. P. Barker .....        | Do.                                               |
| 316 | Concord High School .....             | Concord, N. H. ....    | J. F. Kent .....          | Do.                                               |
| 317 | Brewster Free Academy..               | Wolfborough, N. H. ... | E. H. Lord .....          | Do.                                               |
| 318 | High School .....                     | Portsmouth, N. H. ...  | John Pickard .....        | Do.                                               |
| 319 | Pennington Seminary .....             | Pennington, N. J. .... | J. R. Hamlin .....        | Vice-President.                                   |
| 320 | Hoboken Academy .....                 | Hoboken, N. J. ....    | J. Schreck .....          | Principal.                                        |
| 321 | High School .....                     | Newark, N. J. ....     | H. T. Dawson .....        | Instructor in mathematics.                        |
| 322 | Public High School .....              | Orange, N. J. ....     | W. W. Cutts .....         | Principal.                                        |
| 323 | Newark Technical School.              | Newark, N. J. ....     | H. T. Dawson .....        | Instructor in mathematics.                        |
| 324 | Blair Presbyterian Academy.           | Blairstown, N. J. .... | J. H. Shumaker ...        | Principal.                                        |
| 325 | Stevens High School .....             | Hoboken, N. J. ....    | E. L. Severnack ...       | Assistant principal and professor of mathematics. |
| 326 | Newark Academy .....                  | Newark, N. J. ....     | S. A. Farrand .....       | Head-master.                                      |
| 327 | Dearborn Morgan School.               | Orange, N. J. ....     | D. A. Kennedy .....       | Principal.                                        |
| 328 | New Brunswick High School.            | New Brunswick, N. J.   | C. Jacobs .....           | Superintendent of schools.                        |



## (c) ACADEMIES, INSTITUTES, AND HIGH SCHOOLS—Continued.

|     | Name of institution.                                           | Location.                      | Name of person reporting. | Title or position of person reporting. |
|-----|----------------------------------------------------------------|--------------------------------|---------------------------|----------------------------------------|
| 329 | Fairfield Seminary.....                                        | Fairfield, N. Y.....           | J. M. Hall.....           | Teacher of sciences.                   |
| 330 | College Grammar School.....                                    | Brooklyn, N. Y.....            | L. W. Hart.....           | Principal.                             |
| 331 | Cazenovia Seminary.....                                        | Cazenovia, N. Y.....           | A. White.....             | Teacher of mathematics.                |
| 332 | Ives Seminary.....                                             | Antwerp, N. Y.....             | E. M. Wheeler.....        | Principal.                             |
| 333 | St. Mary's Academy.....                                        | Troy, N. Y.....                | John Hogan.....           | Teacher of classics.                   |
| 334 | Adams Collegiate Institute.                                    | Adams, N. Y.....               | L. B. Woodward.....       |                                        |
| 335 | Grammar School.....                                            | Clinton, N. Y.....             | Isaac O. Best.....        | Principal.                             |
| 336 | Gouverneur Seminary.....                                       | Gouverneur, N. Y.....          | J. F. Forthill.....       | Superintendent of schools.             |
| 337 | Union Classical Institute.....                                 | Schenectady, N. Y.....         | E. E. Voecker.....        | Teacher of mathematics.                |
| 338 | High School.....                                               | Troy, N. Y.....                | J. P. Worden.....         | Professor of mathematics.              |
| 339 | Oxford Academy.....                                            | Oxford, N. Y.....              | F. L. Gamage.....         | Principal.                             |
| 340 | Brooklyn Latin School.....                                     | Brooklyn, N. Y.....            | C. Harrison.....          | Head master.                           |
| 341 | The Utica Academy.....                                         | Utica, N. Y.....               | G. C. Sange.....          | Principal.                             |
| 342 | Rome Free Academy.....                                         | Rome, N. Y.....                | M. T. Scudder.....        | Do.                                    |
| 343 | High School.....                                               | Buffalo, N. Y.....             | M. T. Karnes.....         | Do.                                    |
| 344 | High School.....                                               | Poughkeepsie, N. Y.....        | James Winne.....          | Do.                                    |
| 345 | Burley School for Girls.....                                   | New York, N. Y.....            | Jeannette Fine.....       | Teacher of mathematics.                |
| 346 | Friend's Seminary.....                                         | New York, N. Y.....            | John M. Child.....        | Principal.                             |
| 347 | Central High School.....                                       | Binghamton, N. Y.....          | Fannie Webster.....       | Instructor in mathematics.             |
| 348 | School for Girls.....                                          | New York, N. Y.....            | A. Brackett.....          | Principal.                             |
| 349 | Free Academy.....                                              | Elmira, N. Y.....              | E. T. Wilson.....         | Teacher of mathematics.                |
| 350 | Delavan Academy.....                                           | Delhi, N. Y.....               | W. D. Graves.....         | Principal.                             |
| 351 | Port Jervis Academy.....                                       | Port Jervis, N. Y.....         | John M. Dolph.....        | Superintendent.                        |
| 352 | Yonkers High School.....                                       | Yonkers, N. Y.....             | E. R. Shaw.....           | Principal.                             |
| 353 | High School.....                                               | Albany, N. Y.....              | J. H. Gilbert.....        | Professor of mathematics.              |
| 354 | High School.....                                               | Syracuse, N. Y.....            | O. C. Kinyon.....         | Teacher of physics and mathematics.    |
| 355 | Fremont Institute.....                                         | Fremont, N. C.....             | W. Wills.....             | Instructor in mathematics and Latin.   |
| 356 | Bingham School.....                                            | Bingham School<br>P. O., N. C. | R. Bingham.....           | Superintendent.                        |
| 357 | High School.....                                               | Huntersville, N. C.....        | W. W. Orr.....            | President.                             |
| 358 | Green Town Academy.....                                        | Perrysville, Ohio.....         | J. C. Sample.....         | Do.                                    |
| 359 | High School.....                                               | Zanesville, Ohio.....          | W. M. Townsend.....       | Principal.                             |
| 360 | High School.....                                               | Dayton, Ohio.....              | C. B. Stevens.....        | Do.                                    |
| 361 | Mission House College.....                                     | Cleveland, Ohio.....           | J. W. Groschneech.....    | Professor.                             |
| 362 | Bishop Scott Academy.....                                      | Portland, Oreg.....            | F. E. Patterson.....      | Lieutenant Colonel—mathematics.        |
| 363 | Dickinson Seminary.....                                        | Williamsport, Pa.....          | O. G. Brower.....         | Teacher of mathematics.                |
| 364 | Western Pennsylvania<br>Classical and Scientific<br>Institute. | Mt. Pleasant, Pa.....          | L. Stephens.....          | President.                             |
| 365 | Philadelphia Seminary for<br>Young Ladies.                     | Philadelphia, Pa.....          | Carrie A. Bitting.....    | Librarian.                             |
| 366 | Wyoming Seminary.....                                          | Kingston, Pa.....              | E. B. Howland.....        | Teacher of mathematics.                |
| 367 | Harry Hillman Academy.....                                     | Wilkes Barre, Pa.....          | E. Scott.....             | Principal.                             |
| 368 | William Penn Charter<br>School.                                | Philadelphia, Pa.....          | A. D. Gray.....           | Teacher of mathematics.                |
| 369 | Central High School.....                                       | Chester, Pa.....               | J. F. Reizart.....        | Principal.                             |
| 370 | High School.....                                               | Titusville, Pa.....            | C. E. Rose.....           | Head of mathematical department.       |
| 371 | High School.....                                               | West Chester, Pa.....          | J. E. Philips.....        | Teacher of mathematics.                |
| 372 | High School.....                                               | Scranton, Pa.....              | J. C. Lange.....          | Principal.                             |

(c) ACADEMIES, INSTITUTES, AND HIGH SCHOOLS—Continued.

|     | Name of Institution.                        | Location.                | Name of person reporting. | Title or position of person reporting. |
|-----|---------------------------------------------|--------------------------|---------------------------|----------------------------------------|
| 373 | High School .....                           | Wilkes Barre, Pa. . .    | O. W. Potter .....        | Superintendent of schools.             |
| 374 | High School .....                           | York, Pa. ....           | A. Wauner .....           | Principal.                             |
| 375 | High School .....                           | Carbondale, Pa. ....     | H. J. Hoeckenburg         | Do.                                    |
| 376 | Boys' High School .....                     | Harrisburg, Pa. ....     | J. H. Wert .....          | Do.                                    |
| 377 | High School .....                           | Providence, R. I. ....   | D. W. Hoyt .....          | Do.                                    |
| 378 | Pawtucket High School .....                 | Pawtucket, R. I. ....    | W. W. Curtis .....        | Head-master.                           |
| 379 | High School .....                           | Charleston, S. C. ....   | V. C. Dibble .....        | Principal.                             |
| 380 | High School .....                           | Chattanooga, Tenn. ....  | J. B. Cash .....          | Do.                                    |
| 381 | High School .....                           | Austin, Tex. ....        | J. B. Bryant .....        | Do.                                    |
| 382 | Thetford (Vt.) Academy and Boarding School. | Thetford, Vt. ....       | E. F. Morse .....         | Assistant teacher.                     |
| 383 | Brigham Academy .....                       | Bakersfield, Vt. ....    | F. E. Parlin .....        | Principal.                             |
| 384 | Troy Conference Academy.                    | Poultney, Vt. ....       | C. H. Danten .....        | Do.                                    |
| 385 | High School .....                           | Rutland, Vt. ....        | L. B. Folsom .....        | Do.                                    |
| 386 | Central Female Institute.                   | Gordonsville, Va. ....   | Jas. Dinwiddie....        | Do.                                    |
| 387 | High School .....                           | Richmond, Va. ....       | W. F. Fox .....           | Do.                                    |
| 388 | Thyne Institute .....                       | Chase City, Va. ....     | J. H. Vasey .....         | Superintendent of schools.             |
| 389 | High School .....                           | Charleston, W. Va. ....  | M. R. McGwigan ..         | Principal.                             |
| 390 | West Virginia Academy ..                    | Buckhannon, W. Va. ....  | W. Johnson .....          | Teacher of mathematics.                |
| 391 | Male Academy .....                          | Charlestown, W. Va. .... | E. R. Taylor .....        | Principal.                             |
| 392 | Free High School .....                      | Sheboygan, Wis. ....     | E. G. Haylett. ....       | Do.                                    |
| 393 | High School .....                           | Milwaukee, Wis. ....     | G. W. Peckham ..          | Do.                                    |
| 394 | High School .....                           | Oshkosh, Wis. ....       | R. H. Halsey .....        | Do.                                    |

*What reforms are needed in the teaching of arithmetic?*

- 215. Less adherence to and dependence upon text-books; more thorough primary drill.
- 218. More easy examples.
- 223. More mental work, more analytical work, greater quickness.
- 225. Increase in number of problems under each principle, decrease in number of "catch problems"; more mental work.
- 229. There is too much time put on it in all the lower grades.
- 232. More attention to rapidity, more every-day sums.
- 237. Introduction of quick and labor-saving methods in all business methods.
- 242. Better use of mathematical language; arithmetic as a deductive science.
- 251. More practice in rapid calculation. Many of the unimportant rules should be scarcely touched. My pupils waste energy by scattering too much.
- 255. A more judicious selection of subjects that time be not wasted upon non-essentials.
- 257. More mental arithmetic.
- 262. Something to make it more practical and the student better able to apply it.
- 270. Fundamental operations of arithmetic only should be taught before algebra.
- 274. Text-books are either so childish as to give no inspiration to work after the primary grades, or so abstruse and dependent upon logical reasoning beyond a child's capacity as to discourage.
- 275. Insistence upon accuracy in fundamental operations, and alertness of mind everywhere.

*What reforms are needed in the teaching of arithmetic?—Continued.*

276. More thorough work in elementary rules and in common and decimal fractions.
277. Scholars are pushed ahead altogether too fast, allowed to work slowly and incorrectly; should be drilled in quick addition, etc.
281. More attention to accuracy, rapidity, and practical methods.
283. It should be taught as an art rather than as a science.
286. There should be vastly more drill in fundamental processes.
288. Plenty of examples, more oral and "mental" work.
289. More practice. It seems to me that the agitation for reducing time given to arithmetic is a mistake, though greater economy of effort is possible.
294. Fewer subjects, more speed and accuracy in computation.
297. The difficulty (especially with female teachers) is too great subservience to the text-book—*lack of elasticity in accepting methods.*
300. Hire competent teachers only.
304. More mental arithmetic.
307. More mental work, greater accuracy and rapidity. Scope of the subject reduced.
312. More practical work; judicious omission from ordinary text-book; better development of principles.
314. More mental, less written work.
317. A diminution in the number of subjects and more independent work by the pupil.
324. Particular attention to thoroughness, and abundant practice on fundamental rules and business methods, with the omission of some rules and methods formerly deemed essential.
331. Keep the *keys* out of the way and analyze every problem.
335. To return to the old custom of making the pupil do more thinking. There are too many helps and too much "mince-meat."
338. Many.
340. More philosophy.
341. Return to mental arithmetic, now sadly neglected. More attention to analysis, less to ingenious devices.
344. Do not permit primary teacher to use a *figure* in presence of children till they know everything about numbers one to ten.
346. *The use of the Grube method with beginners, of denominate numbers before abstract, the expansion of the method of analysis in solving problems usually assigned to proportion.*
352. A method that will shorten the time, give the pupils the essentials thoroughly. This will come, I believe, only through the experiments in industrial education.
353. More simplicity, less aiming to puzzle, less work that is wholly theoretical.
359. Brief methods of calculation should be insisted on, also independence.
370. *Less of it, in much less time than is now given to it (Superintendent of Schools).*
372. More attention to mental arithmetic.
375. The use of such books as Colburn's or Venable's Mental Arithmetic thoroughly at first; and the rejection of such methods as have recently been injected into the new Colburn's Mental Arithmetic. The public schools are teaching for show.
380. Books without answers are needed.
392. We should not go too far in seeking to make all divisions in arithmetic practical. Discipline must be held in mind.

*To what extent are models used in teaching geometry?*

The following reported that models were not used: 216, 219, 220, 226, 238, 239, 246, 253, 256, 257, 263, 266, 267, 277, 278, 288, 299, 300, 302, 316, 334, 352, 370, 378, 384, 393.

The following reported "occasionally," "not much," "very little": 217, 218, 222, 231, 233, 236, 240, 241, 242, 243, 244, 245, 251, 255, 258, 265, 269, 276, 282, 293, 294, 296, 296, 307, 309, 318, 324, 326, 332, 335, 337, 338, 339, 341, 348, 350, 351, 354, 356, 358, 360, 364, 366, 367, 372, 375, 385, 387, 390, 391.

Nearly all the remaining reports stated that models were used, specifying, in many cases, that they were found particularly serviceable in teaching solid and spherical geometry.

Those reports which stated that the models were made by the pupils themselves were classified with the group "using models." To teach plane geometry to very young students, or solid and spherical geometry to students of any grade, without the aid of models, is a great mistake.

*To what extent and with what success original exercises?*

All, except about two dozen, reported that original exercises were frequently used, with good success. Some said that one-sixth of the time allotted to geometry was devoted to them, others said one-half of the time; but the large majority of those specifying the relative amount of time given to such work answered one-fourth. Several reporters took occasion to say that the teaching of geometry without introducing original exercises was necessarily more or less of a failure.

*Is the metric system taught?*

Nearly every report showed that this is taught, though in many schools but little attention is given to it. We observed only one instance in which it was "dropped," after having been taught for some years. How long will it be before this country will wheel in line with the leading European nations and adopt this system to the exclusion of the wretched systems now in use among us?

*Which is taught first, algebra or geometry? How far do you proceed in the one before taking up the other?*

Excepting a number less than a dozen, all answered that algebra was taught first. The following complete a course in elementary algebra, before taking up geometry: 215, 218, 225, 226, 230, 235, 237, 239, 239, 245, 246, 247, 260, 263, 266, 267, 272, 273, 278, 282, 283, 284, 289, 290, 292, 294, 298, 299, 301, 307, 314, 316, 318, 321, 323, 324, 326, 327, 328, 335, 337, 338, 344, 345, 353, 354, 355, 359, 360, 369, 370, 372, 376, 377, 380, 382, 383, 385, 387, 389, 394.

The following take up geometry after having carried the student through quadratics: 214, 223, 236, 244, 252, 255, 256, 258, 263, 274, 275, 280, 286, 291, 295, 297, 300, 303, 305, 306, 311, 317, 334, 336, 339, 343, 350, 351, 356, 363, 378, 381, 384, 391.

The following, after having carried the student to quadratics: 216, 217, 223, 250, 251, 257, 264, 302, 357, 367, 373, 386.

Through radicals: 228, 243, 262, 322.

Through equations: 224, 268, 330.

To simple equations: 219, 231, 288, 374, 379.

Through factoring: 276, 325.

Through L. C. M. and G. C. D.: 220.

To fractions: 232, 242, 249.

To involution: 229.

Of those who take up geometry before algebra, 222 teaches Hill's Geometry for Beginners, 234 teaches the simpler parts of geometry, 242 teaches mathematical drawing, involving about sixty geometric problems (without demonstrations), 315 teaches geometry one year, 293 observes the following order of studies: (1) Beginning geometry; (2) algebra; (3) geometry.

In the two institutions, 269 and 270, algebra and geometry are taught together. Is this scheme not worthy of more extended trial?

*Are percentage and its applications taught before the rudiments of algebra or after?*

Nearly all replied that it was taught "before."

The following answered that in their institution it was taught "after": 217, 224 (arithmetic being reviewed with aid of algebra), 238, 239, 252, 266 (review), 340, 347, 355, 360.

In most, if not all these cases, the elements of percentage had been taught to the pupil, before he entered the institution.

In 325 the two subjects are taught "together."

Is it not desirable to introduce the rudiments of algebra earlier than has been the custom in most of our schools?

*Are pupils permitted to use "answer-books" in arithmetic and algebra?*

"Yes," "yes, but not encouraged": 214, 216, 217, 218, 219, 226 (with younger classes), 228, 230, 235, 238, 239 (in arithmetic), 243, 245, 246, 247, 248, 249, 250, 251, 255, 257, 260, 276, 277, 281, 289, 295, 302, 323, 330, 334, 335, 337, 339, 340, 342, 344, 347, 350, 354, 357, 359, 369 (in algebra, but not in arithmetic), 370, 371, 373, 374, 380, 381, 388, 387, 388, 389, 391, 394.

"No": 215, 220, 221, 222, 224, 226 (with older classes), 230, 237, 239 (in algebra, but not in arithmetic), 244, 256 (in algebra), 264, 278, 283, 287, 293, 290, 291, 293, 298, 304, 305, 310, 314, 315, 317, 318, 321, 323, 327, 331, 333, 343, 348, 349, 351, 360, 367, 372 (in algebra), 375, 385, 393.

"Some of the answers:" 214, 215, 221, 223, 224, 225, 226, 235, 236, 237, 238, 239, 240, 242, 244, 245.

*Are students entering your institution thorough in the mathematics required for admission?*

Some of the institutions, especially academies and institutes, have no requirements for admission. In the great majority of reports there was a general complaint that students were "not" well prepared or "by no means" well prepared in the requisites for admission.

The following answered "yes," "fairly so:" 214, 220, 221, 223, 224, 227, 228, 235, 237, 238, 245, 254, 266, 268, 293, 311, 322, 337, 352, 359, 390, 394.

*What are the requirements in mathematics for admission to the institution?*

"Practical arithmetic," "common school arithmetic," was the reply given by one hundred and fourteen institutions.

"Cube root in arithmetic and equations of the second degree in algebra," 217.

Arithmetic and elementary algebra: 222, 230, 273, 288, 303, 357.

Three books in geometry, Brook's Algebra, and arithmetic, 268.

Arithmetic and algebra as far as factoring, 370.

To ratio and proportion in Olney's Practical Arithmetic, 394.

Arithmetic through percentage, 360.

Arithmetic to percentage: 218, 306, 323, 379, 383.

Through fractions in arithmetic: 223, 272, 317.

Fundamental rules in arithmetic: 229, 356, 391.

## V.

### HISTORICAL ESSAYS.

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#### *HISTORY OF INFINITE SERIES.\**

The primary aim of this paper is to consider the views on infinite series held by American mathematicians. But the historical treatment of this or any similar subject would be meagre indeed were we to confine our discussion to the views held by mathematicians in this country. We might as well contemplate the growth of the English language without considering its history in Great Britain, or study the life-history of a butterfly without tracing its metamorphic development from the chrysalis and caterpillar. A satisfactory discussion of infinite series makes it necessary that the greater part of our space be devoted to the views held by European mathematicians.

Previous to the seventeenth century infinite series hardly ever occurred in mathematics; but about the time of Newton they began to assume a central position in mathematical analysis.

Wallis and Mercator were then employing them in the quadrature of curves. Newton made a most important and far-reaching contribution to this subject by his discovery of the binomial theorem, which is engraved upon his tomb in Westminster Abbey. Newton gave no demonstration of his theorem except the verification by multiplication or actual root extraction. The binomial formula is a finite expression whenever the exponent of  $(a+b)$  is a positive whole number; but it is a series with an infinite number of terms whenever the exponent is negative or fractional. Newton appears to have considered his formula to be universally true for any values of the quantities involved, no matter whether the number of terms in the series be finite or infinite.

The binomial theorem was the earliest mathematical discovery of Newton. Further developments on the subject of infinite series were brought forth by him in later works. He made extensive use of them in the quadrature of curves. Infinite series came to be looked upon as a sort of universal mechanism upon which all higher calculations could be made to depend. Special methods of computation, such as contin-

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\* This article was read before the New Orleans Academy of Sciences in December, 1887, and printed in the "Papers" published by that society, Vol. I, No. 2. Some slight changes have been introduced here.

ned fractions, could easily be reduced, it was said, to the general method of infinite series. It thus appears that series were cultivated by the early analysts with great zeal. They seem to have placed perfect confidence in the universality of the method. The mass of mathematicians never dreamed that the unrestricted use of infinite series was undermining mathematical rigor and opening avenues of doubt and error; they had no idea that in reasoning by means of series it was necessary to consider their *convergency* or *divergency*. To show what implicit confidence was placed in infinite series I shall quote a passage from the large, and in many respects excellent, history of mathematics, written by the celebrated Montucla, who flourished during the latter half of the eighteenth century.

In Volume III, page 272, he expresses the desirability of having a more rigid demonstration of the binomial formula than that given by Newton, so that no rational being might ever entertain the faintest doubt of its truth. Among the early English mathematicians there was one who did raise objections to the binomial formula, and of him Montucla says: "Thus we have seen a certain Dr. Green, \* \* \* although professor of physics at the University of Cambridge and a colleague of Cotes, not only doubt it, but pretend that it was false and say he could prove it by examples badly applied; but it does not appear that the English geometers, not even Cotes, his colleague, deigned to reply to him." In the light of modern science, this passage ridiculing Green is very instructive. Time has turned the tables, and the laugh is no longer upon Green, but upon Montucla himself. We now wonder at the recklessness with which infinite series were once used in mathematical reasoning. To be sure, talents of the first order, such as Newton, Leibnitz, Euler, Clairaut, D'Alembert, possessed too much tact and intuitive insight to permit themselves to be dragged to the dangerous extremes and yawning precipices of error, toward which their own imperfect theory of infinite series tended to draw them. And yet, some of them did not escape blunders. The penetrating and teeming mind of Euler, for instance, is said to have fallen into some glaring mistakes by the incautious use of infinite series.

Among the mathematicians who, above all others, made the most unrestricted and reckless use of infinite series, were the Germans. There flourished in Germany during the latter part of the eighteenth century a mathematical school which occupied itself principally with what was termed "combinatorial analysis." This analysis was cultivated in Germany with singular and perfectly national predilection. One of the first problems considered by them was the extension of the binomial formula to polynomials, and the devising of simple rules by which polynomials could be developed into series. The solution of this problem was followed by the problem of "reversion of series." In this connection a quotation from Gerhardt's *Geschichte der Mathematik in Deutschland* (p. 205) is instructive.

Says he: "The advocates of the combinatorial analysis were of the opinion that with the complete solution of this problem (of reversion of series) was given also the general solution of equations. But here they overlooked an important point—the convergency or divergency of the series which was obtained for the value of the unknown quantity. Modern analysis justly demanded an investigation of this point, inasmuch as the usefulness of the results is completely dependent upon it." It thus appears that, through the misuse of infinite series, the Germans were temporarily led to believe that they had reached a result which mathematicians had so long but vainly striven to attain, namely, the algebraic solution of equations higher than the fourth degree. It will be observed that their method lacked generality, since it could at best not yield more than one root of an equation. But in the determination of this one root the combinatorial school was deceived. The result was a mere delusion—a mirage produced by the refraction of the rays of reasoning from their true path while passing through the atmosphere of divergent series.

We proceed now to the further consideration of the binomial theorem. After the time of Newton numerous proofs were given of the binomial theorem. James Bernoulli demonstrated the case of whole positive powers by the application of the theory of combinations.

This proof is excellent, and has retained its place in school-books to the present day. But the general demonstration for the case where the exponent may be negative or fractional was still wanting. Maclaurin was among the first to offer a general demonstration. Soon after he followed a host of proofs, each of which met with objections. It is no great exaggeration to say that these early demonstrations seemed to satisfy no one excepting their own authors. Most celebrated is the proof given by Euler. It is still found in some of our algebras. But Euler's proof has one fault which is common to nearly all that have been given of this theorem. It does not consider the convergency of the series. It seems to me that this fault is fatal. Euler claims to prove that the binomial formula is generally true, but if this formula is actually taken as being universally true, then it can be made to lead to all sorts of absurdities. If, for instance, we take, in  $(a + b)^n$ ,  $a = 1$ ,  $b = -3$ ,  $n = -2$ , then we get from the formula  $\frac{1}{4} = \infty$ .

One might think that absurdities of this kind would have brought about the immediate rejection of all proofs neglecting the tests of convergency, but this has not been the case.

Another infinite series occupying a central position in analysis is the one known to students of calculus as Taylor's theorem. It was discovered by Brook Taylor and published in London in 1715. One would have thought that the instant it was proposed, this theorem would have been hailed as the best and most useful of generalizations. Instead of this it remained quite unknown for over fifty years, till Lagrange



pointed out its power. In 1772 Lagrange published a memoir in which he proposed to make Taylor's theorem the foundation of the differential calculus. By doing so he hoped to relieve the mind of the difficult conception of a *limit* upon which the calculus has been built by Newton and his disciples. The method of limits was then involved in philosophic difficulties of a serious nature. It was therefore very desirable that an explanation of the fundamental principles should be given which should be so clear and rigorous as to command immediate assent. The illustrious Lagrange attempted to supply such an explanation. He boldly undertook to prove Taylor's theorem by simple algebra, and then to deduce the whole differential calculus from Taylor's theorem. In this way the use of limits or of infinitely small quantities was to be dispensed with entirely. If Taylor's theorem be once absolutely granted, then undoubtedly all the rest may be made to follow by processes which are strictly rigorous. But in proving Taylor's theorem by simple algebra without the use of limits or of infinitesimals, Lagrange avoided the whirlpool of Charybdis only to suffer wreck against the rocks of Scylla. The principles of algebra employed by him in his proof were those which he received from the hands of Euler, Maclaurin, and Clairaut. His proof rested chiefly upon the theory of infinite series. But we have seen that this very theory was at that time wanting in mathematical rigor. Consequently, all conclusions evolved from it possessed the same defect. Though Lagrange's method of treating the calculus was at first greatly applauded, objections were afterward raised against it, because the deductions were drawn from infinite series without first ascertaining that those series were *convergent*. This defect was fatal, and to-day Lagrange's "method of derivatives," as his method was called, has been generally abandoned even in France.

At the beginning of this century the avidity with which the results of modern analysis were sought began so far to subside as to allow mathematicians to examine and discuss the grounds on which the several principles were established. The doctrine of infinite series received its due share of attention. In building up a tenable theory of infinite series, the same course became necessary which was followed some years ago in the erection of the Washington monument in the District of Columbia; after the work had proceeded to a certain height, the old foundation was found to be insecure; it had to be removed and to be replaced by another which was broader and deeper. The engineer to whom more, perhaps, than any other we are indebted for the laying of a new and firm foundation to infinite series and to analysis in general, is Cauchy. In the following few but pregnant sentences, taken from his *Cours d'Analyse* Paris, 1821, p. 2, he states the object he has striven to attain: "As far as methods are concerned, I have endeavored to give them all the rigor required in geometry, and never to have recourse to the reasons drawn from the generalization of algebra. Reasons of that kind, although they are very generally accepted, espe-

dially in passing from converging series to diverging series and from real quantities to imaginary quantities, can be considered, it seems to me, only as inductions, fit to give a glimpse of the truth, but which agree little with the boasted exactness of mathematical science. It is furthermore to be observed that they tend to give to algebraic formulæ an indefinite extent, while in reality most of these formulæ remain true only under certain conditions and for certain values of the quantities which they contain." These weighty words of Cauchy became the parole of a new scientific party. Cauchy himself was eminently successful in his work. To him we owe the first correct proof of Taylor's theorem.

He took very strong and positive grounds against the use of divergent series. All series that were not convergent, he pronounced *fallacious*. Taylor's theorem he considered as being wrong whenever the series became divergent. In his *Cours d'Analyse* no place was given to those troublesome divergent infinite series that had previously been the cause of so much vagueness, uncertainty, and even of error.

But Cauchy was not alone in this protest against the unrestricted use of the time-honored methods of analysis. A youthful mathematician from northern Europe, a worthy descendant of mighty Thor, sided with the French mathematician in the contest. This new combatant was the youthful Abel, who, though he died at the premature age of twenty-seven, left behind him an imperishable name. As in the times of myth and fable, Thor, the thunderer, hurled his huge hammer against the mountain giants, so Abel, with his massive intellectual hammer, dealt powerful blows against some of the mathematical methods of his time. Notice an extract from a letter written by him in 1826, which expresses the convictions to which his profound studies had led him. Says Abel:\*

"Divergent series are in general very mischievous affairs, and it is shameful that any one should have founded a demonstration upon them. You can demonstrate anything you please by employing them, and it is they who have caused so much misfortune, and given birth to so many paradoxes. Can anything be more horrible than to declare that

$$0 = 1 - 2^n + 3^n - 4^n + 5^n - \text{etc.},$$

when  $n$  is a whole positive number? At last my eyes have been opened in a most striking manner, for, with the exception of the simplest cases, as for example the geometric series, there can scarcely be found in the whole of mathematics a single infinite series whose sum has been rigorously determined; that is to say, the most important part of mathematics is without foundation. The greater part of the results are correct, that is true, but that is a most extraordinary circumstance. I am engaged in discovering the reason of this—a most interesting problem. I do not think that you could propose to me more than a very small number of problems or theorems containing infinite series, without my being able to make well-founded objections to their demonstration. Do

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\* *Œuvres Complètes de N. H. Abel, Tome I*, Christiania, 1839, p. 264.

so, and I will answer you. Not even the binomial theorem has yet been rigorously demonstrated. I have found that

$$(1+x)^m = 1 + mx + \frac{m(m-1)}{1.2} x^2 + \text{etc.}$$

for all values of  $x$  which are less than 1. When  $x = +1$ , the same formula holds, but only provided that  $m$  is  $> -1$ ; and when  $x = -1$ , the formula only holds for positive values of  $m$ . For all other values of  $m$  the series  $1 + mx + \text{etc.}$ , is divergent. Taylor's theorem, the foundation of the whole infinitesimal calculus, has no better foundation. I have only found one single rigorous demonstration of it, and that is the one given by M. Cauchy in his *Abstract of Lectures upon the Infinitesimal Calculus*, where he has demonstrated that we have

$$p(x+\omega) = p(x) + \omega p'(x) + \frac{\omega^2}{1.2} p''(x) + \text{etc.},$$

as long as the series is convergent; but it is usually employed without ceremony in all cases. • • •

"The theory of infinite series in general rests upon a very bad foundation. All operations are applied to them as if they were finite; but is this permissible? I think not.\* Where is it demonstrated that the differential of an infinite series is found by taking the differential of each term? Nothing is easier than to give examples where this rule is not correct. • • • The same remark holds for the multiplication and division of infinite series. I have begun to examine the most important rules which are (at present) esteemed to hold good in this respect, and to show in what cases they are correct and in what not so. This work proceeds tolerably well and interests me infinitely."

Such is the unequivocal language of Abel. His early death prevented him from carrying all his plans into execution. To him we are indebted for the first rigorous proof of the binomial theorem.†

The views on infinite series held by Cauchy and Abel met with hearty acceptance by leading mathematicians on the continent. Thus, Poisson expressed his views in the following language: "It is taught in the elements that a divergent series can not serve to calculate the approximate value of the function from which it results by development, but sometimes it has apparently been thought that such a series can be used in analytical calculations instead of the function; and although this error is far from being general among geometers, nevertheless it is not useless to point it out, for the results which are obtained by means of divergent series are always uncertain and most of the time inexact."

The conditions for convergency and divergency of different series be-

\* Dirichlet first pointed out that the most elementary algebraic rule, according to which every sum is independent of the arrangement and grouping of the terms to be added, does not necessarily hold true in infinite series.

† *Œuvres Complètes de N. H. Abel, Tome I*, Christiania, 1839, p. 66.

gan to be carefully investigated. No universal criterion for determining whether a given series is convergent or divergent was then known; nor do we possess such a one even to-day.

A question naturally arising at this point of our inquiry is, whether the views of Cauchy and Abel and their co-workers met at once with general acceptance or not. As might almost be expected, they did not, but encountered firm opposition. The old combinatorial school in Germany would not surrender their orthodox views without a struggle. They obstinately defended every doctrine of their mathematical creed. Even such a man as Dr. Martin Ohm, who was really an enemy of the combinatorial school, and whose achievements in mathematics and physics place him among the coryphæi of science, was not willing to join Cauchy and Abel in calling divergent series fallacious. In an essay written by Ohm, entitled, *The Spirit of Mathematical Analysis*,\* he admits that the great mathematicians of his day, as Gauss, Dirichlet, Jacobi, Bessel, Cauchy, do not employ demonstrations conducted with divergent series, while Poisson speaks decidedly against them. "But," says Ohm, "that the series which are used and from which deductions are drawn ought to be always and necessarily convergent is a circumstance of which the author of this essay has not been able at all to convince himself; on the contrary, it is his opinion that series, as long as they are *general*, so that we can not speak of their convergency or divergency, must always, when properly treated, necessarily and unconditionally produce correct results." By a *general* series Ohm means one in which the letters represent *neither magnitudes nor numbers*, but are considered as perfectly *insignificant* (*inhaltlos*). Whenever the letters are made to represent magnitudes or numbers, then the series is no longer a general series, but is a "*numeric*" series, and in that case Ohm admits that an equality can exist between the function and its series only when the series is convergent. It is very difficult to see exactly what meaning shall be given to letters upon which algebraic operations are to be performed, when the letters represent neither magnitudes nor numbers. Nor is it easy to see in what way formulæ involving these empty, meaningless letters—these "ghosts of departed quantities"—can furnish rigorous methods in mathematical analysis. In fact, this theory of *general* series containing *insignificant* letters is one of the last shifts to which the opponents of the new school resorted; one of the last subterfuges before giving up a contest which had become entirely hopeless.

If we pass from Germany to England we meet there with another mathematician who championed the old cause. I refer to George Peacock, who is well known to mathematicians for his *Algebra* and his *Report*, made in 1833 to the British Association, On the Recent Progress and Present State of Certain Branches of Analysis.

Peacock states his views with more clearness than Ohm had stated his. He bases his argument on what he calls the "principle of the per-

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\**The Spirit of Mathematical Analysis and its Relation to a Logical System*, by Dr. Martin Ohm; translated by Alexander John Ellis, London, 1843.

manence of equivalent forms," which he considers to be the real foundation of all rules of symbolic algebra. According to this principle, all the rules and operations of arithmetic which have been established by numerical considerations are adopted without reference to relative magnitude; the symbols of algebra are taken to be perfectly general and unlimited in value, and the operations to which they are subject are equally general. To illustrate: In arithmetic we can subtract a smaller number from a larger, but we cannot subtract a larger from a smaller; that is to say, we can subtract 3 from 5, but not 5 from 3. In algebra, on the other hand, no limitation whatever is placed upon the relative values of minuend and subtrahend; there we can subtract 5 from 3 and give the answer a rational interpretation. By the principle of the permanence of equivalent forms every result obtained from mathematical operations must always be a correct result, no matter what the relative values of the quantities be upon which the operations are performed. Peacock applies this principle to the subject of infinite series.

He says (p. 205, Report for 1833) that "the series

$$(1 + x)^n = 1 + nx + \frac{n(n-1)}{2}x^2 + \text{etc.}$$

indefinitely continued, in which  $n$  is a particular value (a whole number), though general in form, must be true also, in virtue of the principle of the permanence of equivalent forms, when  $n$  is general in value as well as in form." Instead of being always a positive whole number, the exponent  $n$  may, therefore, be negative or fractional, and the above formula still holds true.

Now, the principle of the permanence of equivalent forms laid down by Peacock is not self-evident, nor did it become known by intuition: on the contrary, it is merely an induction, and can, therefore, hardly be taken as a reliable basis upon which to settle a disputed question; for this very question may be one in which this law established by mere induction might fail. But even granting the principle of the permanence of equivalent forms to be generally applicable, does it really follow from it that infinite series are true, whether they be convergent or divergent? In order to discuss this point let us examine a series resulting from the division of the numerator of an algebraical fraction by its denominator, such as  $\frac{1}{1-a}$ .

From arithmetic we get the simple but general statement that the numerator of a fraction divided by its denominator is equal to the quotient plus the remainder (if there be any remainder). By the principle of the permanence of equivalent forms this must be true of fractions involving any quantities whatever. Now, if we divide 1 by  $1-a$  we get  $1 + a + a^2 + a^3 + \frac{a^4}{1-a}$ . We observe there is a remainder.  $\frac{a^4}{1-a}$ . If we carry the division further there is still a remainder. No

matter how far the division proceeds it will not end, and a remainder will still exist. We may express this fact by writing  $\frac{1}{1-a} = 1 + a +$

$a^2 + \dots + a^n + \frac{a^{n+1}}{1-a}$ . Now, if  $a$  has a value less than unity the

remainder approaches zero, and we may therefore write  $\frac{1}{1-a} = 1 + a + a^2 + \text{etc., ad infinitum}$ . This infinite series is correct whenever  $a < 1$ . But, according to Peacock, it would follow from the principle of the permanence of equivalent forms that, if this series is correct for  $a < 1$ , it must be true for all values of  $a$ . Hence the series is true when  $a > 1$ , in which case the series is divergent. Now, this conclusion appears to be inadmissible, because Peacock does not examine the remainder. When  $a < 1$ , the remainder approaches zero, and can therefore be neglected; but if  $a > 1$ , then we shall find that the remainder does not approach zero, and therefore cannot be neglected.

To neglect it would be to violate the principle of the permanence of equivalent forms. This principle demands that whenever there is a remainder it shall always be considered and expressed, no matter how far the division be continued. If in the above series we take  $a = 2$  and neglect the remainder, then we get

$$-1 = 1 + 2 + 2^2 + 2^3 + \dots \text{ad infinitum,}$$

which is an absurdity. But if the remainder be taken into account, then we have

$$-1 = 1 + 2 + 2^2 + 2^3 + \dots + 2^n + \frac{2^{n+1}}{-1}.$$

This equation is always true, no matter how great  $n$  may be; that is to say, no matter how far the division be continued. From similar considerations in other series it would appear that divergent series are false and absurd, except when written with the remainder.

And yet not only Peacock, but even De Morgan was not willing to reject divergent series. Though De Morgan criticised the new school for the unconditional rejection of divergent series, he cannot be pronounced an enthusiastic supporter of the old school. In an article in the Transactions of the Cambridge Philosophical Society, Volume VIII, Part I, he says: "I do not pretend to have that confidence in series which, to judge from elementary writers on algebra, is common among mathematicians, not even convergent series." His views on this subject will be more fully elucidated by the following quotation from his article on "Series" in the Penny Cyclopædia: "A divergent series is, arithmetically speaking, infinite; that is, the quantity acquired by summing its terms may be made greater than any quantity agreed on at the beginning of a process. . . . Nevertheless, as every algebraist knows, such series are frequently used as the *representatives of*

*finite quantities.* It was usual to admit such series without hesitation; but of late years many of the continental mathematicians have declared against divergent series altogether, and have asserted instances in which the use of them leads to false results. Those of a contrary opinion have replied to the instances, and have argued from general principles in favor of retaining divergent series. Our own opinion is that the instances have arisen from a misunderstanding or misuse of the series employed, though sufficient to show that divergent series should be very carefully handled; but that, on the other hand, no perfectly general and indisputable right to the use of these series has been established *a priori*. They always lead to true results when properly used, but no demonstration has been given that they must always do so."

About the time when Peacock made his report to the British Association, Cauchy was developing new and valuable results on the subject of infinite series. With the aid of the integral calculus he was conducting a careful investigation of the conditions which must be fulfilled in order that a function be capable of being developed into a convergent infinite series. He found that four conditions must be satisfied: (1) The function must *admit of a derivative*. (2) The function must be *uniform*, that is, for any particular value for  $x$  the function must have only one value. (3) The function must be *finite*. (4) The function must be *continuous*, that is, it must change gradually as the variable passes from one value to another. These results greatly strengthened the position held by the new school, and notwithstanding the adroit arguments brought forth by various mathematicians of the old school in favor of divergent series, the leading mathematicians of to-day have rejected the old views and adopted those of Cauchy and Abel. In the theory of functions, a branch of mathematics which is now assuming enormous proportions, the convergency of all series employed is carefully and scrupulously tested. In late years more reliable criteria have been invented for determining the convergency. Standard treatises on the subject devote the larger part of their space to the consideration of convergency. Whenever a series is divergent, then either the remainder is inserted or the series is unceremoniously rejected. Indeed, divergent series are now looked upon by our best mathematicians as being nothing more than exploded chimeras.

Having briefly traced the history of infinite series in Europe, we shall consider the views on this subject held by American writers. Previous to the beginning of this century the text-books on algebra used in this country were all imported from abroad. About the only mathematical books published in America before 1800 were arithmetics and some few books on surveying. The earliest imported algebras came from Great Britain. The most important of them were the algebras of Maclaurin, Saunderson, Charles Hutton, John Bonnycastle, and Thomas Simpson. These writers belonged to what we have called the old school. As

might be expected the subject of series was handled by them with the same looseness and recklessness as by the older school of mathematicians on the continent. Thus, in Hutton's Mathematics, which was a standard work in its day, considerable attention was paid to series, but the terms "convergent" and "divergent" were not even mentioned. The earliest American compiler of a course of mathematics for colleges was Samuel Webber. In 1801 he published his "Mathematics." The algebraical part was necessarily elementary in character, and of course contained no formal criteria for convergency. Whatever defects Webber's Algebra may have, it has also its merits. It is pleasing to observe that as far as the author had entered upon the subject of infinite series he was on the right track. Speaking of a certain divergent series he says that "it is false, and the further it is continued the further it will diverge from the truth" (p. 291). This language possesses the true ring; it is free from the discords of error, and we regret that American writers of later date have not imitated it.

In 1814, thirteen years after the publication of Webber's Mathematics, appeared the algebra of Jeremiah Day, of Yale College. All things considered, Day's Algebra is superior to Webber's, but on the particular subject of series it can hardly be said to excel. President Day points out, to be sure, that a certain series must converge in order to come nearer and nearer to the exact value of the fraction from which the series was derived, but he does not even hint at the insecurity or absurdity of divergent series. He gives no demonstration of the binomial theorem, but speaks of it as being universally true.

Four years after the publication of Day's Algebra, John Farrar, professor of mathematics at Harvard, published An Introduction to the Elements of Algebra, \* \* \* Selected from the Algebra of Euler. On the continent of Europe Euler's writings were at that time justly considered as the most profound, and as affording the finest models of analysis. Yet his writings were not faultless. His views on series were those of the old school. The discussion of series as given in Farrar's Euler demands our attention, because subsequent American writers were doubtless greatly influenced by it. On page 76 of this book, the fraction  $\frac{1}{1-a}$  is resolved by division into an infinite series. The following comments upon it are then made: "There are sufficient grounds to maintain that the value of this infinite series is the same as that of the fraction  $\frac{1}{1-a}$ . What we have said may at first seem surprising, but the consideration of some particular cases will make it easily understood. \* \* \*

If we suppose  $a=2$ , our series becomes  $=1+2+4+8+16+32+64$ , etc., to infinity, and its value must be  $\frac{1}{1-2}$  that is to say,  $\frac{1}{-1} = -1$ , which at first sight will appear absurd. But it must be remarked that if we wish to stop at any term of the above series we can not do so



without joining the fraction which remains." Now this last sentence is certainly a true statement. No fault can be found with it. It simply means that we must consider the *remainder*, the very thing which the new school persistently insists upon. But the next statement made by the author is objectionable. Says he: "Were we to continue the series without intermission, the fraction indeed would be no longer considered, but then the series would still go on." This really amounts to saying that when the series becomes infinite, the remainder shall not be considered.

Now, if the remainder is not taken into account, then we can say in the language of Webber that the further the series is continued, "the further it will diverge from the truth," hence it must be "false."

In addition to this abridgment of Euler's Algebra, Professor Farrar published a translation from the French of Lacroix's Algebra. Lacroix's works are justly celebrated for their purity and simplicity of style. Though more cautious in his statements than the majority of elementary writers, he must still be classed as belonging to the old school. In his algebra \* he speaks of divergent series as leading to consequences that are "absurd." The binomial theorem is proved by Lacroix for the case when the exponent is a positive integer, but the proof for the other cases is omitted. In the light of modern mathematics this was a wise omission. A correct proof of the general theorem is too difficult for pupils beginning algebra. But the easier proofs are incorrect. Hence it is preferable to give no proof at all than give a wrong one. But Professor Farrar was not satisfied with this omission. In his translation he adds a foot-note, with the erroneous statement that the binomial formula is "equally applicable to cases in which the exponent is fractional and negative," and he demonstrates this theorem in the last part of his Cambridge Course of Mathematics ("On the Differential and Integral Calculus") without, of course, considering the question of convergency.

Charles Davies, who was appointed professor of mathematics at the United States Military Academy at West Point in 1823, published in 1834 an algebra modeled after the large French treatise of Bourdon. This algebra is familiarly known as "Davies' Bourdon," and, like all other books of Professor Davies, has had a very extensive circulation in all parts of the United States. However excellent this treatise may be in other respects, on the subject of infinite series and the treatment of the binomial theorem it is very defective.

From what has been said it will be seen that the foreign authors whom our American writers took for models in compiling their algebras belonged to the old school. Our early American writers clung faithfully to the orthodox opinions of this school. The only dissenting voice came from Samuel Webber, and it was so feeble that it escaped

\* Elements of Algebra, by S. F. Lacroix, translated by John Farrar. Second edition, Cambridge, N. E., 1825, p. 241. (This second American edition was translated from the eleventh edition, printed in Paris in 1815.)

† *Ibid.*, p. 152.

all notice. But what, you may ask, were the views held by later American mathematicians?

In answer to this I need not discuss each author individually. If we except a few very recent writers, then we may say that on infinite series the sins of one are quite generally the sins of all. You may consult the large and extensive Treatise on Algebra, of Charles Hackley, or the Elementary Treatise on Algebra, by James Ryan; the Elementary and Higher Algebra, by Theodore Strong; the University Algebra, by Horatio N. Robinson; the Algebra for Colleges and Schools and Private Students, by Joseph Ray; the Elements of Algebra, by Major D. H. Hill; the University Algebra, by Edward Olney; the Binomial Theorem and Logarithms, by William Chauvenet; the Treatise on Algebra, by Elias Loomis. You may consult these and many others, and you will find that they are all swayed more or less by the orthodox ideas of the old school. A few of them give tests for convergency, but none of them treat divergent series with that severity which these mischievous expressions deserve. If divergent series are false, then it ought to be so stated; the student should be informed of the fact that they *are* false. Judging only from American algebras, we might almost conclude that Cauchy, Abel, Poisson, Dirichlet had never lived, or that their ideas had been long since expunged from the creed of true science. Of the algebras which the writer has examined a few of very recent date are the only ones to which this statement is not applicable. But even these give demonstrations of the binomial theorem which are deficient in rigor. The writer has not seen a single proof of this theorem for negative or fractional exponents in any American algebra which is not open to well-founded objections. Our writers often begin the general proof with an equation in which the sign = expresses always a *numerical equality*, and, finally, arrive at an equation (the generalized binomial formula) in which the sign = *does not* express a *numerical equality*, except under certain limiting conditions. The student is not informed in what way such a change in the meaning of the sign = has been brought about, nor is he told by what process of logic this sudden metamorphosis is permissible.

It may be argued that the final equation expresses a *formal truth*. But is this *formal truth* anything more than a perforated shell from which the kernel of *useful truth* has been removed? When the equation expresses merely a *formal truth*, can it be used for numerical calculations? No. Can the series be employed in course of analytical demonstrations in place of the function? No, for it leads to uncertainty, and perhaps even to error. What then is this *formal truth* good for?

There is an American algebraist who says that the formula,

$$(1+x)^n = 1 + nx + \frac{n(n-1)}{2} x^2 + \text{etc.},$$

"is at once true when  $n$  is positive or negative, entire or fractional, real or imaginary, rational or irrational." Yet, it was pointed out long

ago by Abel and others that even when the conditions for convergency are satisfied there are still other points to be considered before we are entitled to write the sign of equality between the function and the series. The expression  $(1+x)^n$  has in general a multiplicity of different values. In fact, the only case in which it has a single value is when the exponent  $n$  is an integer. Whenever  $n$  is a rational fraction, the expression has more than one value; whenever  $n$  is irrational or imaginary, the expression has an infinite number of values.

The series itself, on the other hand, has always only one value. Now, if we place the function  $(1+x)^n$  equal to the series, then the question arises, which one out of the possibly infinite number of functional values is equal to the one value of the series?

A process in which American books are deficient in rigor is the multiplication of one infinite series by another. Some of our books exhibit not the slightest hesitation in multiplying by one another any two series whatever, and placing their product equal to the product of the functions from which the two series were obtained. The same confidence is placed in the process of multiplying *infinite* series as in that of multiplying *finite* expressions. But as a matter of fact, when one or both series are divergent, then their product is an absurd result. It is therefore necessary that both series be convergent. But, strange to say, this necessary condition has not always been found sufficient. There are cases in which the product of two convergent series may actually be a divergent series. For instance, Cauchy has shown that the series

$$1 - \frac{1}{\sqrt{2}} + \frac{1}{\sqrt{3}} - \frac{1}{\sqrt{4}} + \frac{1}{\sqrt{5}} - \dots$$

is convergent, but that its square

$$1 - \frac{2}{\sqrt{2}} + \left( \frac{2}{\sqrt{3}} + \frac{1}{2} \right) - \left( \frac{2}{\sqrt{4}} + \frac{2}{\sqrt{6}} \right) + \dots$$

is divergent. The investigation of this difficulty has led to the proof that only the so-called "absolutely convergent" series can be multiplied into each other without liability of error. Thus while our elementary books teach that all infinite series can be multiplied by one another, the most recent and most advanced treatises on the subject teach that only convergent series of a particular kind can be multiplied into each other so as to lead to trustworthy results.

If we had time we could go on and examine the development of functions into series by the method of indeterminate co-efficients, as taught in our elementary books. We should meet with several points which are open to well-founded objections. But we can not enter upon this subject now.

The writing of a good elementary text-book is one of the most difficult undertakings. It is hardly advisable to subject to rigorous proof every rule and every process which ought to go into an elementary text-book on algebra.

Many of the proofs would be either exceedingly difficult to the pupil or entirely beyond his comprehension. In consequence of this the problem arises to decide what had best be proved and what might best be assumed without demonstration. It is easy to see how the opinions of able and experienced teachers may differ in making this choice. But there is one point upon which there should be no difference of opinion. Whatever is placed in an elementary text-book ought to be, as near as we can make it, the truth and nothing but the truth. If a subject is so difficult that it can not be stated in an elementary way without *mis-stating* it, then it had best be left out altogether. Whatever reasoning would be fallacious and wrong when placed in an advanced treatise must be equally fallacious and wrong when placed in an elementary book. If divergent series are unreliable, absurd, or false in advanced articles written by Cayley and Abel, in the *Cours d'Analyse* by Jordan and by Cauchy, or in the *Calcul Différentiel* by Serret, then divergent series must be equally unreliable, absurd, or false in the elementary algebras of Loomis, Davies, or Robinson. Now, if divergent series are actually untrustworthy and fallacious (and the leading mathematicians of to-day consider them so), would it not be best to make a statement to that effect in our elementary algebras and to give at least some of the simplest criteria for determining the convergency. If a *correct* proof of the binomial theorem for negative and fractional exponents is too long and difficult to find a place in an elementary algebra, why should it not be entirely omitted from algebra, and inserted afterward in the differential and integral calculus? There it can be deduced at once as an immediate consequence of Taylor's theorem. But in that case we must be sure that our calculus gives a correct proof of Taylor's theorem.

Unfortunately, many of our American works give what may be called the old proof of this theorem, which proof is pronounced unsatisfactory by all standard writers on the calculus. De Morgan does not consider it a demonstration at all, but treats this old process as "nothing more than rendering it highly probable that

$$\Phi(a + h) \text{ and } \Phi(a) + \Phi'(a)h + \Phi''(a)\frac{h^2}{2} + \text{etc.},$$

have relations which are worth inquiring into." Todhunter likewise objects to the old proof, and especially to "the use of an infinite series without ascertaining that it is convergent."

We regret to say that many of our American books on calculus are just as reckless and unscrupulous in the treatment of infinite series as our algebras are. But this assertion can not be applied sweepingly to all our works on this subject. Take some of the more recent publications, as, for instance, Byerly's *Calculus*. On page 118 of Byerly's *Differential calculus* the following statement is made and emphasized by italics. "*It is very unsafe to make use of divergent series or to base any reasoning upon them.*" This doctrine contradicts the doctrine taught in our algebras. If Byerly's *Calculus* is correct, then our algebras must

be wrong. Imagine the confusion which will arise in the mind of the student. While he is studying algebra he learns that the binomial theorem is *universally* true. When Byerly's Calculus is placed in his hands, he discovers that this same theorem is not always true, but holds good only when certain conditions are satisfied. The thoughtful student will become disgusted at such glaring contradictions in the presentation and explanation of a science which, in the hands of a careful mathematician, can be made to be the most accurate and consistent of all sciences. In closing, we give the following summary of the views presented in this paper:

1. In calculating with or reasoning by means of infinite series, the question of convergency should always be considered. If a series is divergent, then the sign of equality should not be placed between that series and the function from which it was developed. If the sign of equality be used in that way, then it expresses an absurdity, which is no less an absurdity when found in an elementary text-book than when found in a more advanced treatise.

2. Those parts of the subject which are too difficult for correct treatment in algebra, may be assumed temporarily without demonstration, and may afterward be proved in the differential and integral calculus. This suggestion applies particularly to the binomial formula for all cases in which its exponent is not a positive integer.

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### ON PARALLEL LINES AND ALLIED SUBJECTS.

There are few subjects in mathematics which have been discussed to greater extent than that of parallel lines. The various attempts at improving the theory of this subject may be classified under four heads: I. In which a new definition of parallel lines is suggested. II. In which a new axiom, different from Euclid's, is proposed. III. In which efforts have been made to deduce the theory of parallels from the nature of the straight line and plane angle. IV. In which, during the present century, the whole subject of geometrical axioms has been re-investigated and searched to the very bottom, and in which the novel and startling conclusion has been reached that the space defined by Euclid's axioms is not the only possible non-contradictory space. This gave birth to what is now termed non-Euclidian geometry.

It is our intention to take up the discussion under the above four heads, with a view of presenting the ideas advanced by American mathematicians or given in text-books used in this country.

#### I.--NEW DEFINITIONS.

Euclid's definition of parallel lines is as follows: "*Parallel straight lines are such as are in the same plane, and which being produced ever so far both ways do not meet.*" This definition has been retained by the larger

number of American writers,<sup>1</sup> and seems indeed the most desirable one to use in elementary geometry.

*Parallel lines are lines everywhere equally distant.* This definition has been adopted by Hutton,<sup>2</sup> Webber,<sup>3</sup> T. Walker,<sup>4</sup> A. Schuyler,<sup>5</sup> and probably by other authors whose books have not been examined by the writer. This definition has never been popular here since the time of Webber. Chief among older and foreign authors who used it are Wolf, Dürer, Boscovich, T. Simpson (in the first edition of his Elements), and Bonycastle. Olavius assumed that a line which is everywhere equidistant from a straight line is itself straight. This axiom or postulate, which, by the way, does not hold true in pseudo-spherical space (according to the ordinary methods of measurement), lies hidden in disguise in the above definition. The objections to that definition are that it is an advanced *theorem*, rather than a definition; that it involves a number of considerations of great subtlety; and that it has to be abandoned as a fundamental definition in the more generalized view which is taken of this science in what is called non-Euclidian geometry. To be rejected for similar reasons is the following definition.

*Two lines that make equal angles with a third line, all being in the same plane, are parallel.* This is given by H. N. Robinson.<sup>6</sup> It was used in France by Varignon and Bezout, and in England by Oooley.

*Parallel lines are straight lines which have the same direction.* This definition has been growing in favor in this country. The reason of its popularity lies in the fact that it appears to contribute to the brevity and simplicity of demonstrations. Its validity will be considered further on. One of the first, perhaps the first, to use it in this country was James Hayward, teacher of mathematics at Harvard College.<sup>7</sup> It was used by Benjamin Peirce,<sup>8</sup> N. Tillinghast,<sup>9</sup> Charles W. Hackley,<sup>10</sup> Davies and Peck,<sup>11</sup> Eli T. Tappan,<sup>12</sup> William T. Bradbury,<sup>13</sup> and G. A. Wentworth.<sup>14</sup>

In England the concept of direction was made the basis of a work

<sup>1</sup> Of the books examined by the writer, the following employ this definition: Farrar, F. H. Smith, and Davies, in their respective editions of Legendrie; also, Chauvenet, Newcomb, Venable, Halsted, Loomis, Grund, Olney, Haseler, Hunter, Whitlock, and Wentworth (in the revised edition of his geometry, 1888).

<sup>2</sup> Hutton's Mathematics, edited by Robert Adrain, New York, 1831, Vol. I., p. 275.

<sup>3</sup> Webber's Mathematics, Cambridge, N. E., 1806, p. 340.

<sup>4</sup> Walker's Elements of Geometry, Boston, 1831, p. 30.

<sup>5</sup> Schuyler's Elements of Geometry, 1876, p. 33.

<sup>6</sup> Elements of Geometry, Plane and Spherical Trigonometry, Cincinnati, 1862, p. 11.

<sup>7</sup> Geometry, Cambridge, 1829, p. 7.

<sup>8</sup> Elementary Treatise on Plane and Solid Geometry, Boston, 1837.

<sup>9</sup> Plane Geometry for the use of schools, Concord and Boston, 1841.

<sup>10</sup> Elementary Course of Geometry for the use of schools and colleges, New York, 1847.

<sup>11</sup> Mathematical Dictionary, Article, "Parallel Lines."

<sup>12</sup> Treatise on Plane and Solid Geometry, "Ray's Series," Cincinnati, 1864.

<sup>13</sup> Elementary Geometry and Trigonometry, Boston, 1872.

<sup>14</sup> Elements of Plane and Solid Geometry, Boston, 1878. All editions of this most popular book, except the revised edition of June, 1888, contain the above definition of parallels.

on geometry by J. M. Wilson, 1868, but in his new book of 1878 the whole theory of direction is ignored.

## II.—NEW "AXIOM."

Euclid proves in his Elements (I, 27) that "If a straight line falling on two other straight lines make the alternate angles equal to one another, the two straight lines shall be parallel to one another." But before any other step can be made, it is necessary either to prove or assume that in every other case the two lines are not parallel.

Being unable to prove this, Euclid assumed it. His assumption consists in what is generally called the twelfth, by some the eleventh "axiom:" "If a straight line meet two straight lines so as to make the two interior angles on the same side of it taken together less than two right-angles, these straight lines, being continually produced, shall at length meet on that side on which are the angles which are less than two right-angles." It has been validly urged against Euclid that this statement is far from being axiomatic. But H. Hankel\* has shown that Euclid himself placed this among the postulates (where it more properly belongs) and not among the axioms. The mistake of calling it an axiom was due to later editors. Euclid thus placed the whole difficulty of parallel lines in an assumption.

It has been objected that this assumption is not sufficiently simple and obvious. Accordingly, Playfair proposed the following "axiom": "Two straight lines which intersect one another can not be both parallel to the same straight line." This is merely Euclid's "axiom" in a better and more obvious form. It has been adopted by the best American works on geometry.†

A large number of our geometries give neither Euclid's nor Playfair's "axiom," but pretend to *prove* some "theorem" which states, in substance, what is equivalent to Euclid's "axiom." This leads us to the next heading.

## III.—"PROOFS."

Since neither Euclid's nor Playfair's "axiom" is axiomatic, innumerable attempts have been made to *prove* one or the other. Until within twenty years it was believed by many leading mathematicians that valid proofs could be deduced from reasonings on the nature of the straight line. But the researches which led to the development of non-Euclidian geometry have, at last, made it clear that all such attempts must necessarily remain fruitless.

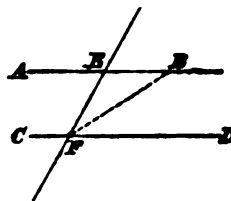
We shall call attention to a few so-called proofs found in text-books used in this country. Hutton‡ proves the "theorem" that "when a line

\* *Vorlesungen über Complex Zahlen und ihre Funktionen*, p. 52.

† The writer has seen it in the geometries of Davies, F. H. Smith, Venable, Leemis, Chauvenet, Hunter, Brooks, Grund, Newcomb, Halsted, and Wentworth (in his revised edition, 1887).

‡ Hutton's *Mathematica*, edited by Robert Adrain, New York, 1831, Vol. I, p. 281.

intersects two parallel lines, it makes the alternate angles equal to each other" (which is the equivalent of Euclid's "axiom")—in the following manner: If angles  $AEF$  and  $HFD$  are not equal, "one of them must be greater than the other; let it be  $EFD$ , for instance, which is the greater, if possible, and conceive the line  $FB$  to be drawn, cutting off the part or angle  $EFB$  equal to the angle  $AEF$ , and meeting the line  $AB$  in the point  $B$ . Then, since the outward angle  $AEF$ , of the triangle  $BEF$ , is greater than the inward opposite angle  $EFB$  (th. 8); and since these two angles also are equal (by the construction), it follows that those angles are both equal and unequal at the same time, which is impossible. Therefore, the angle  $EFD$  is not unequal to the alternate angle  $AEF$ ; that is, they are equal to each other." The error of this proof lies in the (implied) statement that the line  $FB$  must always intersect the line  $AB$ , which is, virtually, an assumption of the thing to be proved. We know that in pseudo-spherical geometry one of the angles (say  $EFD$ ) is greater than the other, and that the line  $FB$  does not cut  $AB$ .



This same proof is given in Davies' *Elementary Geometry*, p. 26. Attempts at proving the "parallel-axiom" were made also by Haessler, by a writer (James Wallace) in the *Southern Review* (Vol. I, 1828), and by A. O. Twining, in *Silliman's Journal* (1846, pp. 47 and 89).

Olney\* proves Playfair's axiom in this way: "Let  $AB$  be the given line, and  $G$  the given point, there can be one and only one perpendicular through  $G$  to  $AB$  (127). Let this be  $FE$ . Now through  $G$  one and only one perpendicular can be drawn to  $FE$ . Let this be  $OD$ . Then is  $OD$  parallel to  $AB$  by the proposition (just proved in the book), and it is the only such parallel, since it is the only perpendicular to  $FE$  at  $G$ ." The fallacy of this lies in the assumption that every line in the plane, drawn through the point  $G$  and not cutting the line  $AB$  must necessarily be perpendicular to  $EF$ .

An interesting attempt to prove Euclid's axiom is given anonymously in *Orelle's Journal* (1834), and translated and published by W. W. Johnson in the *Analyst* (Vol. III, 1876, p. 103). According to De Morgan, this proof is due to Bertrand. Professor Johnson says that "this demonstration seems to have been generally overlooked by writers of geometrical text-books, though apparently exactly what was needed to put the theory upon a perfectly sound basis." The error in the proof seems to lie in the statement that, if lines  $AB$  and  $OD$  in a plane lie on the same side of the line  $AC$  and are equally inclined to it, then the infinite space  $BACD$  must always be less than the infinite space  $BAE$ , provided only that angle  $BAE$  be not taken less than angle  $BAC$ . That this is not true in spherical geometry, is seen very readily; nor is it true in pseudo-spherical geometry.

\* *Treatise on Special or Elementary Geometry*, University edition, New York, 1878, p. 70. In later editions this proof is omitted and Playfair's axiom assumed.



Those authors who adopt the idea of "direction," and define parallels as lines having the same direction, dispose of the whole subject in a trice. To them the theory of parallels gives no trouble. The difficulties of the subject are all hidden from sight by the notion of "direction." The following is the proof given by Hayward\* of a "theorem" which says, in substance, the same thing as the "parallel-axiom." "The straight line has the same direction in every part. An angle is the inclination of one straight line to another; that is, the inclination to each other of these two directions. Two parallel straight lines have the same direction. Therefore, a straight line (which has but one direction in every part), meeting two straight lines which have but one direction in all their parts, must have the same inclination to both. That is, *when a straight line meets two parallel straight lines, the angles which it makes with the one are equal to those which it makes with the other.* Clearer evidence of the truth of this proposition can not be desired." A little further on we shall consider the question, Is the directional method scientific?

A mathematician whose attempts to prove the "parallel-axiom" were awarded with the most fruitful results, was M. Legendre. In the earliest editions of his celebrated Elements, he makes a direct appeal to the senses. In the seventh edition he assumes that a magnitude increases without limit when perpetual increase is all that is demonstrable. But his early proofs of the "parallel-axiom" did not satisfy even him, and he temporarily returned to Euclid's mode of treating parallels. Farrar's second edition of Legendre, brought out in 1825, contains this last presentation of the subject. Further investigations led Legendre to the beautiful result that the theory of parallels can be strictly deduced, if it can previously be shown that the three angles of a triangle are equal to two right angles. In Farrar's Legendre of 1831 and 1833 is given Legendre's attempt to prove this theorem without previously assuming the "parallel-axiom." The attempted proof is somewhat long, and introduces an infinite series of triangles. In Volume XII of the Memoirs of the Institute is a paper by Legendre, containing his last attempt at a solution of the problem. Assuming space to be infinite, he proved satisfactorily that it is impossible for the sum of the three angles of a triangle to exceed two right angles; and that if there be any triangle the sum of whose angles is two right angles, then the same must be true of all triangles. But in the next step, to show that this sum can not be less than two right angles, his demonstration failed.

#### IV.—RECENT RESULTS.

Some years before Legendre completed the above investigations, Lobatchewsky of Russia adopted the bold plan of constructing a geometry without assuming the parallel-axiom. He succeeded in this, and

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\* Elements of Geometry, p. ix.

it opened up the subject of non-Euclidian geometry. His discoveries were first made public in a discourse at Kasan, February 12, 1826. We can not here discuss the investigations on this subject that were made by Lobatchewsky, Gauss, Bolyai, Beltrami, Riemann, Helmholtz, Klein, and our own Newcomb.\*

We shall only state that the possibility of constructing geometries upon different assumptions than those made by Euclid has become evident. We know now that, assuming space to be of uniform curvature, there are really three sorts of geometries possible—those of spherical space, of Euclid's space, and of pseudo-spherical space. Each of these is consistent in itself. These three do not contradict each other, but form rather one great system of which each is only a special case.

Much light has been thrown by the above generalizations upon the vexed subject of geometric "axioms." Do our more recent text-books profit by these researches? Some of them do. Take, for instance, Newcomb's *Elementary Geometry*. On page 14 we read, "We are to think of the geometric figures as made of perfectly stiff lines which can be picked up from the paper and moved about without bending or undergoing any change of form or magnitude." This statement embraces a property that is a common characteristic of all three geometries mentioned above, and distinguishes that group from any other which might be conceived, namely, the property that a figure can be moved about without undergoing either stretching or tearing.† "Through a given point one straight line can be drawn, and only one, which shall be parallel to a given straight line." The assumption, "one straight line can be drawn," divides the Euclidian and pseudo-spherical geometries from the spherical geometry; for in the last there are no (real) straight lines that are parallel to each other. The assumption contained in the words "and only one," separates Euclidian geometry from the pseudo-spherical. In the latter more than one line can be drawn through the same point, none of which intersect a given straight line. The assumptions thus made completely define the geometry of Euclid from the other two. A good statement of the assumptions about Euclid's space is found also in Halsted's *Geometry*.

This may be a convenient place to inquire into the scientific value of the term "direction" as a fundamental geometric concept. Professor Halsted says, in the preface to his geometry: "In America the geometries most in vogue at present are vitiated by the immediate assumption and misuse of that subtle term, 'direction;' and teachers who know something of the non-Euclidian, or even the modern synthetic geometries, are seeing the evils of this superficial 'directional' method. \* \* \*

\* For a bibliography of hyper-space and non-Euclidian geometry, see a paper by George Bruce Halsted in the *American Journal of Mathematics*, Vol. I, pp. 261-276, and pp. 384, 385; Vol. II, pp. 65-70.

† The property that figures can be moved about "without bending" distinguishes the geometry on an ordinary plane or on a sphere from that on a surface like the cone.

The present work, composed with special reference to use in teaching, yet strives to present the elements of geometry in a way so absolutely logical and compact, that they may be ready as rock-foundation for more advanced study." We quote on this subject also from a prominent German work of Dr. Wilhelm Killing.\* "The attempts to establish a natural basis for geometry have, thus far, not been accompanied with desired success. The reason for that lies, in my opinion, in this, that even as geometry has been compelled to abandon the concept of direction (*Begriff der Richtung*) in the sense required by the parallel-axiom, so it will not be able to hold on to the concept of distance (*Begriff des Abstandes*) as a fundamental concept, and must, therefore, pass far beyond the non-Euclidian forms of space (*Raumformen*) in the narrower sense." Thus, according to Dr. Killing, geometry has discarded the term direction as a fundamental concept.

There are several objections which can be urged against the term "direction." When we think of two straight lines as having different directions, we imagine ourselves placed on the point of intersection and looking along one of the lines, then the other. The term seems clear as long as we apply it to lines which intersect each other, or which coincide with one another. In the latter case we say that the two lines have the same direction. But we, as yet, have no geometric meaning of the phrase "the same direction," except when used of lines having a common point. Simply because lines which intersect each other have *different* directions, we can not logically conclude that lines which do not meet each other have the *same* direction. This objection was urged by De Morgan twenty years ago in his review of J. M. Wilson's geometry.† Says he, "There is a covert notion of direction, which, though only defined with reference to lines which meet, is straightway transferred to lines which do not. According to the definition, direction is a relation of lines which *do* meet, and yet lines which have the same direction can be lines which *never* meet. . . . How do you know, we ask, that lines which have the same direction never meet? Answer—lines which meet have *different* directions. We know they have; but how do we know that, under the definition given, the relation called *direction* has any application at all to lines which never meet? The notion of limits may give an answer; but what is a system of geometry which introduces continuity and limits to the mind as yet untaught to think of space and of magnitude?"

Benjamin Peirce says, in the preface to his geometry, "The term *direction* is introduced into this treatise without being defined; but it is regarded as a simple idea, and to be as incapable of definition as *length*, *breadth*, and *thickness*." But in case of length we have clear and rigorous means of testing by the method of superposition whether two lengths are equal or unequal. The same is true of breadth and thick-

\* *Die Nicht-Euclidischen Raumformen in Analytischer Behandlung*, Leipzig, 1895, p. iv.

† *Athenæum*, July 17, 1875.

ness. In case of *direction*, on the other hand, comparisons cannot always be instituted, at least not without becoming involved in logical difficulties. We have no satisfactory means of telling whether two non-intersecting lines in a plane have the same or different directions. We are not even sure that the relation of direction can be applied to them. On a pseudo-spherical surface a whole pencil of lines can be drawn through a given point which do not intersect a given line. The lines in this pencil do not have the same directions with respect to one another. The question then arises, which one, if any, of these lines in the pencil has the same direction as the given line? If we can not distinguish between the presence and absence of a quality, then that quality is useless.

But suppose that, for the sake of argument, we waive the above objection, and say that parallel lines have the same direction. After defining straight line, angle, parallel lines, in accordance with the concept of "direction," we can reason in the same way as Hayward does in the quotation given under the third heading. But that mode of treating parallels excludes the possibility of the existence of pseudo-spherical geometry, inasmuch as it renders absurd the statement that two or more lines intersecting one another may exist, none of which intersect a third line, for lines in a plane which have different directions with respect to one another cannot all have the same direction with respect to a third line. The above use of the term direction involves assumptions as to the character of space which are too narrow to admit the use of that term as a fundamental concept. As far as possible, our Euclidian geometry should be made to rest upon concepts which need not be abandoned when we take a generalized view of the science. Our treatment of the elements should be a "rock-foundation for more advanced study."

One of the many objections to all attempts to found the elements of geometry on the word "direction" is stated by Professor Halsted in the following manner:\* "Direction is a common English word, and in Webster's Dictionary, our standard, the only definition of it in a sense at all mathematical is the fourth: 'The line or course upon which anything is moving . . . ; as, the ship sailed in a southeasterly direction.' Direction, to be understood in any strict sense whatever, posits and presupposes three fundamental geometric ideas, namely, straight line, angle, parallels. After the theory of parallels founded upon an explicit assumption has been carefully established, a strict definition of direction may be based upon these three more simple concepts, and we may use it as Rowan Hamilton does in his Quaternions. But in American geometries, for example Wentworth's, the fallacy *petitio principii* is three times repeated by defining the three component parts of direction, each by direction itself."

Professor Halsted objects also to the word "distance" as a funda-

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\* Letter to the writer, November 17, 1888.

mental idea. He says, in the preface to his elements, that the attempt, "to take away by definition from the familiar word 'distance' its abstract character and connection with length-units, only confuses the ordinary student. A reference to the article 'Measurement,' in the *Encyclopædia Britannica*, will show that around the word 'distance' centers the most abstruse advance in pure science and philosophy. An elementary geometry has no need of the words 'direction' and 'distance.'"<sup>\*</sup> This view receives support from Dr. Killing in the above quotation. Professor Halsted has introduced the new word *sect*, meaning "part of a line between two definite points," and corresponding to the German word *Strecke*. The objections to the word distance are stated by him in the following words: \* "Distance is also a common English word, and Webster as its first definition gives, 'An interval or space between two objects; the length of the shortest line which intervenes between two things that are separate. Every particle attracts every other with a force \* \* \* inversely proportioned to the square of the distance. Newton.' Thus, distance posits shortest line and *length*, therefore measurement, therefore *ratio*, never treated before the fifth book in the Euclidian geometry, and never adequately treated at all in any other geometry without the use of the whole theory of limits. Yet American geometries, for example Wentworth's, give in place of the well-known simple proof of the theorem that any two sides of a triangle are together greater than the third, the abstruse assumption 'a straight line is the shortest distance between any two points,' and that after having explicitly said that there is only *one distance* between two points."

Before concluding this essay we should like to express our belief that detailed discussions of the fundamental geometric concepts should be avoided with students beginning geometry. Such discussions can be carried on with more profit when reviewing the subject near the end of the course, or when beginning the study of non-Euclidian geometry. In this connection I can not forbear quoting from a letter of Dr. E. W. Davis, of the University of South Carolina. Says he, "This getting down to the ultimate basis of our assumptions is a long and painful process, and should not be insisted upon in *elementary* instruction. The first beginning in mathematical reasoning should be reasoning that shows the student facts that are new to him. It disgusts him to have continually *proved* to him what he has always *known*, or to *begin* by asking him to *doubt* what he can not help but deem *true* in spite of all our fine logic. Confidence in logic should be gained by long experience in *predicting* by it the *unforeseen*, before we proceed by it to invalidate deeply-rooted and universally cherished conceptions." While we fully indorse these views, we at the same time insist upon a scientific treatment of geometry in our text-books, for the two following reasons: (1) When the student advances to a more generalized view of the subject, he will find that his first studies in this line rested upon a rock-foundation, and that the old edifice can be enlarged without being first de-

\* Letter to the writer, November 17, 1898.

molished; (2) A teacher, like an honest preacher, prefers to teach doctrine which is, to the best of his knowledge, logically and philosophically true.

### ON THE FOUNDATION OF ALGEBRA.

From Peacock's Report to the British Association, in 1833, on the Recent Progress and Present State of Certain Branches of Analysis (p. 188) we quote the following words: "Algebra was denominated in the time of Newton *specious* or *universal arithmetic*, and the view of its principles which gave rise to its synonym has more or less prevailed in almost every treatise upon this subject which has appeared since his time. In a similar manner, algebra has been said to be a science which arises from that generalization of the processes of arithmetic which results from the use of symbolical language; but though in the exposition of the principles of algebra arithmetic has always been taken for its foundation, and the names of the fundamental operations in one science have been transferred to the other without any immediate change in their meaning, yet it has generally been found necessary subsequently to enlarge this very narrow basis of so very general a science, though the reason of the necessity of doing so, and the precise point at which, or extent to which, it was done, has usually been passed over without notice."

From the same Report (p. 284) we quote the following: "In the early part of the last century the algebra of Maclaurin was almost exclusively used in the public education of this country. It is unduly compressed in many of its most essential elementary parts, and is unduly expanded in others which have reference to his own discoveries.

• • • It was, subsequently, in a great measure superseded, in the English universities at least, by the large work of Saunderson. It was swelled out to a very unwieldy size by a vast number of examples worked out at great length; and it labored under the very serious defect of teaching almost exclusively arithmetical algebra, being far behind the work of Maclaurin in the exposition of general views of the science."

There was indeed, in those days, some opposition at Cambridge (England) to the use of negative quantities in algebra. Among Cambridge algebraists who argued against the use of such quantities were Baron Francis Maseres (fellow of Clare), author of a dissertation on the negative sign in algebra (1758), and W. Frend, author of Principles of Algebra (1796-99). Both of these persons set themselves against Saunderson, Maclaurin, and the rest of the world; for they rejected negative quantities no less than imaginaries; and, like Robert Simson, "made war of extermination on all that distinguished algebra from arithmetic."<sup>\*</sup>

The algebras studied by the early teachers and pupils in this country were all English works. Maclaurin, Saunderson, Thomas Simpson,

<sup>\*</sup> *Schola Acadmica*: Some Account of the Studies at English Universities in the Eighteenth Century, by C. Wordsworth, 1877, p. 6d.

Hutton, Bonnycastle, and Bridge were authors that could be found in the libraries of our American professors of mathematics. As pointed out by Peacock, these authors began their treatises with arithmetical algebra, but gradually and disguisedly introduced negative quantities.

It is to be expected that our early compilers of algebra and writers on mathematics should imitate the English. The first publication in this country of a mathematical work which can, perhaps, lay some little claim to originality, was the work by Jared Mansfield, entitled, *Essays, Mathematical and Physical, Containing New Theories and Illustrations of some very Important and Difficult Subjects of the Sciences.*\*

In the first essay, Mansfield says that "affirmative quantities are to be added, negative ones to be subtracted." Negative quantities "can never exist alone or independently; . . . for to suppose a compound where the elements have been all exhausted by the diminishing quantities, and something still left, would be very absurd. This, however, may be the case apparently, and in reality no absurdity follow. Thus the case above mentioned,  $8-12$ , is absurd in itself, when pure numbers are considered; But an algebraist who knows how often the signs are changed in order to develop the unknown quantity, and that the quantities are often assumed without knowing on which side the difference lies, views this expression as nothing else than the difference of 12 and 8, or as  $12-8$ ; for those terms which have the sign  $+$  prefixed to them, have precisely the same effect on those to which the sign  $-$  is prefixed, as those which have the sign  $-$  on those which have the sign  $+$ . The signs are totally indifferent, excepting as to the operations, and where no operation is to be performed they are to be neglected."

These views suggest an algebra purely arithmetical, which finds it as impossible to give a *clear* explanation of negative quantities as it would of the imaginary  $\sqrt{-1}$ . In fact, negative quantities are the true "imaginaries" of such an algebra.

Day's Algebra contains a detailed discussion of positive and negative quantities. "A negative quantity is one which is required to be subtracted. When several quantities enter into a calculation, it is frequently necessary that some of them should be added together, while others are subtracted. The former are called affirmative or positive, and are marked with the sign  $+$ ; the latter are termed negative, and distinguished by the sign  $-$ ." But when a negative quantity is greater than a positive, how can the former be subtracted from the latter? "The answer to this is, that the greater may be supposed first to *exhaust* the less, and then to leave a remainder equal to the difference between the two." The interpretation of positive and negative quantities is then given by employing the ideas of *gain* and *loss*, *ascent* and *descent*, *north* and *south* latitude, etc.

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\* The work contains eight essays. Their titles are as follows: (1) On the Use of the Negative Sign in Algebra, (2) Geometrical Properties, (3) Nautical Astronomy, (4) Orbicular Motion, (5) Investigation of the Lock, (6) Fluxionary Analysis, (7) Theory of Gunnery, (8) Theory of the Moon.

The treatment of this subject in Day's Algebra is essentially the same as that given by all American books, excepting those of recent date. It is only within the last ten or fifteen years that our writers on algebra (such as Olney, Wentworth, Wells, Thomson and Quimby, Bowser, Newcomb, Oliver, Wait, and Jones, Van Velzer and Slichter), have explicitly *assumed* the existence of negative as well as positive quantities at the very beginning of their text-books, and have clearly explained that the series of algebraic numbers is assumed as going out from 0 indefinitely in both directions, and that the signs + and - are used not only as signs of *operation* to indicate addition and subtraction, but also as signs of *quality* to indicate the nature of the quantities as positive or negative.

The algebra that is usually found in our school-books, wherein quantities are considered as being one or the other of two diametrically opposite kinds, has been called *single algebra*. It differs from *pure arithmetic* in assuming the existence not only of positive, but also of negative quantities. Neither pure arithmetic nor single algebra is perfect in itself, since each leads to expressions that are meaningless. In pure arithmetic,  $a - b$ , whenever  $a < b$ , expresses an impossibility and is an "imaginary value." In single algebra this ceases to be impossible, but there we are led to another impossibility, another "imaginary," namely,  $\sqrt{-1}$ .

By proceeding one step further in our generalization we come to *double algebra*, in which the existence of complex quantities (of the form  $a \pm \sqrt{-1}b$ ) is assumed. Geometrically, such a quantity represents a line of definite length in some one definite direction in a plane. This algebra is capable of giving meaning to all the expressions to which it leads and is, therefore, perfect in itself. Some of our recent text-books (as Wentworth's, Bowser's, Newcomb's, Van Velzer and Slichter's, and especially Oliver, Wait, and Jones's) give a more or less complete account of this kind of algebra in their chapters on imaginaries. Triple, quadruple (quaternions), and other multiple algebras have been invented.

It will be seen that the true foundations of algebra have not been understood before the present century. The theory of imaginaries in double algebra has been developed chiefly by Argand, Gauss, and Cauchy. The philosophy of the first principles of algebra has been studied by Peacock, De Morgan, Hankel, and others. They established the three great laws of operations, *i. e.*, the distributive, associative, and commutative laws. A flood of additional light on this subject was thrown by the epoch-making researches of Hamilton, Grassman, our own Peirce, and their followers. They conceived new algebras, whose laws differ from the laws of ordinary algebra.\*

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\* An excellent historical sketch of Multiple Algebra, by J. W. Gibbs, of Yale, will be found in the Proceedings of the American Association for the Advancement of Science, Vol. XXXV, 1886.



### DIFFERENCE BETWEEN NAPIER'S AND NATURAL LOGARITHMS.\*

The term "Napierian logarithms" has been used in three different senses: (1) as meaning Napier's logarithms, or the ones invented by him and published in 1614 in his *Mirifici Logarithmorum Canonis Descriptio*; (2) as a synonym for "natural logarithms;" (3) as conveying the first and second meanings combined, and, thereby, implying that the natural logarithms are the ones invented by Napier. Though this last use of the term is inadmissible, because the logarithms invented and published by Napier are really different from the natural logarithms, it has, nevertheless, been the most prevalent; especially has it been prevalent in this country.

An examination of the algebras which have been in use in our schools will at once convince us that this error has been very general. We may consult the algebras of Ray, Greenleaf, Ficklin, Schuyler, Loomis, Robinson, F. H. Smith, Hackley, Davies, Bowser, Stoddard and Henkle, Thomson and Quimby, and many others, and we find it stated either that Lord Napier selected for the base of his system  $e = 2.718 \dots$ , or that he assumed the modulus equal to unity. Either of these two statements is equivalent to saying that the logarithms invented by Napier are identical with the natural logarithms. Some authors make statements like the following one, taken from the revised edition of Wells's *University Algebra* (p. 363): "The system of logarithms, which has  $e$  for its base, is called the Napierian system, from Napier, the inventor of logarithms."

The objection to statements like this is that they almost invariably mislead the student. What inference is more natural than that *Napierian* logarithms were invented by *Napier*? Some explanation ought therefore to be made guarding against this error.

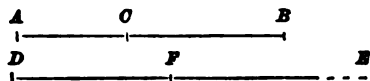
But I have seen only two American books doing this, namely, J. M. Peirce's *Mathematical Tables*, and Van Velzer and Slichter's *Course in Algebra* (of which a preliminary edition has just appeared). In these two books the truth is conveyed in plain words that Napier's logarithms differ from the natural. It is the object of this article to explain that difference.

It is important to note that, in Napier's time, our exponential notation in algebra had not yet come into use. To be sure, Stifel in Germany and Stevin in Belgium had, previous to this, made some attempts at denoting powers by indices; but this notation was not immediately appreciated, nor was it generally known to mathematicians, not even to the celebrated Harriot, whose algebra appeared long after Napier's death. It is one of the greatest curiosities in the history of mathe-

\* This article has been published in the *Mathematical Magazine*, Vol. II, No. 1, and is here reproduced with some very slight changes.

matics that logarithms should have been constructed before exponents were used. We know how naturally logarithms flow from the exponential symbol, but to Napier this symbol was entirely unknown.

The interesting inquiry then arises, What was Napier's treatment of logarithms? It may be briefly stated as follows:



Let  $AB$  be a line of definite length,  $DE$  a line extending from  $D$  indefinitely. Imagine two points set in motion at the same time, and with the same initial velocity; the one point moving from  $D$  toward  $E$  with uniform velocity; the other from  $A$  to  $B$  with a velocity decreasing in such a way that when it arrives at any position,  $C$ , its velocity is proportional to the remaining distance,  $BC$ . While the latter point travels a distance,  $AC$ , suppose the former to move over the space  $DF$ . Napier called  $DF$  the logarithm of  $BC$ . He first applied this idea to the calculation of a table of logarithms for the natural sines in trigonometry. In the above figure,  $AB$  would represent the sine of  $90^\circ$  or the radius, which was taken by him equal to 10,000,000 or  $10^7$ .  $BC$  would be the sine of an arc, and  $DF$  its logarithm.

"The *logarithm*, therefore, of any sine is a number very nearly expressing the line which increased *equally* in the meantime, while the line of the whole sine decreased *proportionally* into that sine, both motions being equal-timed, and the beginning equally swift."<sup>\*</sup>

This treatment of the subject is certainly very unique. Let us now establish the relation between these Napierian logarithms and our natural logarithms. Let  $m=AB$ ,  $x=DF$ ,  $y=BC$ , then  $AC=m-y$ . The velocity of the point  $C$  is  $\frac{d(m-y)}{dt}=ry$ ,  $r$  being a constant. Integrating, we have

$$-\text{Nat. log } y = rt + c.$$

When  $t=0$ , then  $y=m$ , and  $c=-\text{Nat log } m$ . The velocity of the point  $C$  is  $rm$ , when  $t=0$ . Since the two points start with the same velocity, we have  $\frac{dx}{dt}=rm$  as the uniform velocity of the point  $F$ . Hence  $x=rm t$ . Substituting for  $t$  and  $c$  their values, and remembering that, by definition,  $x=\text{Nap log } y$ , we get

$$\text{Nap log } y = m \text{ Nat log } \frac{m}{y}$$

The constant  $m$  was taken equal to  $10^7$ . Substituting we get

$$\text{Nap log } y = 10^7 \text{ Nat log } \frac{10^7}{y}$$

as the equation expressing the relation between Napierian and natural logarithms.

<sup>\*</sup> Definition 6, p. 3, of Napier's *Mirifici Logarithmorum Canonis Descriptio*, etc., 1614.

That there is a difference between the two is evident at once. We easily observe the characteristic property of Napierian logarithms, that they *decrease* as the number itself *increases*. This property alone should have been a sufficient guard against declaring the two systems identical. The Napierian logarithm of  $10^7$  is equal to zero. The Napierian logarithms of numbers smaller than it are positive; those of numbers larger than it are negative, or, in the language of Napier, "less than nothing." In further illustration we give the following:

Nap. log. 1 = 161 180 956.509; Nat. log. 1 = 0

Nap. log. 2 = 154 249 484.703; Nat. log. 2 = 0.6 931 473

Nap. log. 10 = 138 155 105.578; Nat. log. 10 = 2.3 025 851

The question may be asked what *base* Napier selected for his system. We answer that he did not calculate his logarithms to a base at all. He never thought nor ever had any idea whatever of a *base* in connection with logarithms. The notion of a base suggested itself to mathematicians later, after the algorithm of powers and exponents, both integral and fractional, had come to be better understood.

If we inquire what the base to the logarithms in Napier's tables would have been had he used one, then it will be found that it does not coincide with the natural base  $e$ , but is very nearly equal to its reciprocal. In theory, that base is exactly equal to the reciprocal of  $e$ , as will be seen from the following relation,\* which is merely another form of the one given above,

$$\frac{y}{10^7} = \left(\frac{1}{e}\right)^{\frac{\text{Nap log } y}{10^7}}$$

The base  $\frac{1}{e}$  would not lead accurately to Napier's logarithmic figures, because the inventor's method of calculation was necessarily somewhat rude and inexact. The modulus of his logarithms is not equal to 1, but nearly equal to  $-1$ . If the base were exactly  $\frac{1}{e}$ , then the modulus would be exactly  $-1$ ; for the modulus of any system of logarithms is the logarithm, in that system, of the Napierian base  $e$ .

The first calculation of logarithms to the base of the natural system was made by John Speidell in his *New Logarithms*, published in London, in 1616, or five years after the first appearance of Napier's logarithmic tables.<sup>†</sup>

\* To make the theory of exponents applicable to Napier's logarithms, it becomes necessary to divide the number  $y$  by  $10^7$ , otherwise the base raised to the zero power would not be equal to unity. This division really amounts to making the length of the line  $AB$  equal to 1 instead of  $10^7$ . If this be done, then *Nap. log. y* must also be divided by  $10^7$ , so as to retain the inventor's conception that the two points on the lines  $AB$  and  $DE$ , respectively, move with equal initial velocities.

† The error of calling the Napierian and natural logarithms one and the same system has been widespread. We may pardon the celebrated Montucla, the eldest prominent writer on the history of mathematics, for making this mistake (Montucla,

## CIRCLE SQUARERS.

It would be strange if America had not produced her crop of "circle-squarers," just as other countries have done. Our history of them will be quite incomplete. We have not gone out of our way to seek the acquaintance of this singular race of "mathematicians," nor have we avoided them. A few individuals have come across our path, and we proceed to tell about them for the benefit and edification not so much of mathematicians as of psychologists. The mathematician contemplates the products of only sound intellects; the psychologist studies also the utterings of minds that are or seem to be diseased.

The history of the quadrature of the circle is not without its sober lessons to mathematicians. It extends back through centuries almost to the beginning of geometry as a science.

The student of the history of mathematics is impressed by the fact that this science, more than any other, has always been a progressive one. He does not find a period in authentic history during which mathematics was not cultivated quite successfully by some nation or other. The earliest contributions were made by the Babylonians and Egyptians, then came the Greeks, then the Hindoos, then the Arabs, and finally the Europeans. Like metaphysics, mathematics has encountered fundamental problems apparently of insurmountable difficulty. But it has generally had the good fortune to perceive that fortifications can be taken in other ways than by direct attack with open force; that, when repulsed from a direct assault, it is well to reconnoitre

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*Histoire des Mathématiques*, Tome II, Paris, 1758, p. 21), but there is hardly any excuse for a modern writer, such as Hofer (*Histoire des Mathématiques depuis leurs Origines jusqu'au Commencement du Dix-neuvième Siècle*, Paris, 1874, p. 378), for stumbling over the same stone. The difference between the two systems was pointed out in Germany by Karsten in 1768, Kästner in 1774, and Mollweide in 1808, but no attention was paid to their writings on this subject. A lucid proof of the non-identity of the two systems was given by Wackerbarth ("*Logarithmes Hyperboliques et Logarithmes Népériens*," *Les Mondes*, Tome XXVI, p. 626). The French mathematician Biot wrote likewise on this subject (*Journal des Savants*, 1835, p. 259), as did also De Morgan in England (*English Cyclopædia*, Article "Tables"). Still more recently attention has been called to this matter by J. W. L. Glaisher (*Encyclopædia Britannica*, 9th ed., Article "Logarithms"), and by Siegmund Guenther (*Untersuchungen zur Geschichte der mathematischen Wissenschaften*, Leipzig, 1876, p. 271). The writings of these scientists do not seem to have received the attention they deserve, and the erroneous notion of the identity of Napierian and natural logarithms still continues to be almost universal.

Napier's original works on logarithms are very scarce. The *Miristici Logarithmorum Canonis Descriptio*, etc., *Edinburgi*, 1614, can be found in the Congressional Library in Washington and in the Ridgway Library in Philadelphia. The latter library has also the English edition of the above work, translated by Edward Wright in 1616. "So rare are these original editions that, of the two greatest historians of logarithms, Delambre never saw the Latin edition and Montucla never heard of the English." (Mark Napier's Biography of Lord Napier, p. 379).

and occupy the surrounding country and discover the secret paths by which the apparently unconquerable position can be taken.\*

From this we can draw the valuable lesson that it is not always best to "take the bull by the horns."

The value of this precept may be seen by giving an instance in which it has been violated. The history of the quadrature of the circle is in point. An untold amount of intellectual energy has been expended upon this problem, yet no conquest has been made by direct assault. The circle-squarers existed in crowds even before the time of Archimedes and in all succeeding ages in which geometry was cultivated, down even to our own. After the invention of the differential calculus abundant means were introduced to complete the quadrature, if such a thing were possible. Persons versed in mathematics became convinced that the problem could not be solved, and dropped it. But those who still continued to make attempts upon this "enchanted castle," as it was supposed to be, were completely ignorant of the history of the subject, and generally misunderstood the conditions of the problem. "Our problem," says De Morgan,† "is to square the circle with the *old allowance of means*: Euclid's postulates and nothing more. We can not remember an instance in which a question to be solved by a *definite method* was tried by the best heads and answered at last *by that method*, after thousands of complete failures."

But great advance has been made on this problem by approaching it from a different direction and by newly discovered paths. Lambert, an Alsacian mathematician, proved in 1761 that the ratio of the circumference of a circle to its diameter is incommensurable. Only nine years ago Lindemann, a German mathematician, demonstrated that this ratio is also transcendental, and that the quadrature of the circle by means of the ruler and compass only, or by means of any algebraic curve, is *impossible*.‡ He has thus shown by actual proof that which keen-minded mathematicians had long suspected, namely, that the great army of circle-squarers have, for more than two thousand years, been assaulting a fortification which is as impossible to be torn down as the firmament of heaven is by the hand of man.

Now-a-days, a person claiming to have solved this problem is ranked by mathematicians in the same class with inventors of "perpetual motion," and discoverers of the "fountain of perpetual youth." A very peculiar characteristic of circle-squarers, or quadrators, as Montucla calls them, is that they cannot be convinced of their errors. The first American quadrator we shall mention is William David Clark Murdock, who, in a pamphlet of eight pages, bearing no date, gives a *Demonstration of the Quadrature of the Circle*.

The next man on our list is John A. Parker, whose work on *The Quad-*

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\* H. Hankel, *Entwicklung der Mathematik in den letzten Jahrhunderten*, p. 16.

† English Cyclopædia; article, "Quadrature of the Circle."

‡ *Mathematische Annalen*, Band XX, p. 213.

ature of the Circle (1851) was reviewed in the New Englander of February, 1852. The most prominent characteristics of this work, says the reviewer, are, a contempt for "algebra," and a grudge against "professors." The author proves that all geometers from Euclid to his (Parker's) great forerunner, Seba Smith, have been but blockheads in the very A B C's of their science. He solves in a twinkling the vexed problem of the "three bodies." He seems ashamed of his usher, Seba Smith, and takes him to task for "stealing his thunder." Over twenty years of experience seem to have made him no wiser. In 1874 he republished his book of over three hundred pages in almost exactly its original form.

The next publication is the following: The Regulated Area of the Circle and the Area of the Surface of the Sphere, by Charles P. Bouché, Citizen of the United States of North America, Cincinnati, 1854. It covers sixty pages. The author says: "Notwithstanding the perfection at which mathematics may have arrived in rectilineal geometry, planimetry, and stereometry, yet with regard to the *curve line*, as well as the spherical surface, we have remained in great darkness till it pleased the author of Spheres to afford us some light in this respect, and from a source little expected, *i. e.*, through the medium of a plain, but a moderately cultivated, seeker after truth. By the assiduous application of mind and the blessing of God, I have ultimately succeeded in correcting some great errors respecting *curvilinear geometry*."

The next circle-squarer on our list is Lawrence Slater Benson, the author of a geometry. In 1879 he published in New York a work called Mathematics in a Dilemma, in which he also gives an extremely interesting history of his efforts on this subject. He says that after completing a course of studies at college in 1858, and while residing on his former place in South Carolina, his mind drifted into geometrical abstractions. He published new modes of demonstrating the quadrature in 1860 and in 1862. He says that he offered "one thousand dollars to any one who could refute the result which I gave for the circle, namely, that the perimeter of its equivalent square *is exactly equidistant between the squares circumscribed and inscribed about the circle; the sides of all the squares being respectively parallel*. This offer and demonstration drew me in many discussions, for mathematicians claim themselves able to prove that this intermediate square is just equal to an inscribed decagon in the circle; whence they argue that I make the circle *too small*. Committees of expert mathematicians—professors in colleges were selected to decide this issue; but no decision was made. Therefore, in 1864, while the Civil War was raging, I ran the blockade and visited Europe, and laid my demonstration before scientific societies and distinguished mathematicians there." He then says that he returned to New York and published a simplification of the Elements of Euclid, with the repudiation of the *reductio ad absurdum*. He says that these changes met the approval of Professor Docharty of the Col-

lege of the City of New York, and that, in 1873, Charles Davies published a book where he also repudiated the *absurdum* reasoning. "For nearly twenty years mathematicians and myself have been at logger-heads on the issue made by me about the circle. I now propose to set at rest all doubts against the demonstration published by me in 1860 and 1862." In more recent years Mr. Benson's efforts to revolutionize mathematics have been unabated.

Dr. A. Martin tells us of a quadrator who deposited with him a manuscript, in 1885, proving that the long sought for ratio is exactly  $3\frac{1}{4}$ . Mr. Faber, the writer of it, distinguished himself also in other branches of mathematical inquiry. In a pamphlet of thirty-four pages, in 1872, "Theodore Faber, a citizen of the United States, New York," makes the "extraordinary and most significant discovery of a *lacking link* in the demonstration of the world-renowned Pythagorean problem, utterly disproving its absolute truth, although demonstrated as such for twenty-three centuries." In justice to Mr. Benson, it should be remarked that he, too, is waging war against Euclid, I, 47.\*

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\*Since writing the above, we have received from Dr. Artemas Martin a copy of the Notes and Queries, Vol. V, Nos. 6 and 7, June and July, 1888, giving a Bibliography of Cyclometry and Quadratures. From this article we see that Theodore Faber has appeared in print also on the subject of the quadrature of the circle. The article gives over twenty publications, besides the ones mentioned above, by American writers who believe that they have found the true and exact ratio.

## APPENDIX.

### BIBLIOGRAPHY OF FLUXIONS AND THE CALCULUS.

#### TEXT-BOOKS PRINTED IN THE UNITED STATES.

HUTTON, CHARLES. *Course of Mathematics*, in two volumes.

American editions, revised by Robert Adrain, appeared in 1812, 1816(?), and 1822. Evert Duyckinck brought out an edition in New York in 1828. Another edition appeared in 1831. The second volume contains a short account of the doctrine of fluxions, using the Newtonian notation.

VINCE, REV. S. *The Principles of Fluxions*, first American edition, corrected and enlarged. Philadelphia: Kimber & Conrad. 1812. Pp. 256.

Employs the Newtonian notation.

BEZOUT. *First Principles of the Differential and Integral Calculus, or the Doctrine of Fluxions*, from the Mathematics of Bezout, and translated from the French for use of students of the University at Cambridge, New England. Boston, 1824. Pp. 195.

This book forms a part of Farrar's Cambridge Mathematics. It is the first work published in this country employing the notation of Leibnitz and the infinitesimal method. "In the Introduction, taken from Carnot's *Réflexions sur la Méthode du Calcul Infinitésimal*, a few examples are given to show the truth of the infinitesimal method, independently of its technical form." This is done by explaining that there is a "compensation of errors."

RYAN, JAMES. *The Differential and Integral Calculus*. New York, 1828.\* Pp. 398.

"The works which I have principally used in preparing this treatise are Lacroix, Lardner, Bouchardat, Garnier, and Du Bourguet's Differential and Integral Calculus; Lagrange's *Calcul des Fonctions*, Simpson's Fluxion's, Peacock's Examples on the Differential and Integral Calculus, and Hirsch's Integral Tables" (advertisement). The first section of the book is given to "preliminary principles," in which the three methods of Newton, D'Alembert, and Lagrange are explained. The method adopted by the author is that of limits, but no formal definition of the term "limit" is given. The symbol (0), indicating the absence of quantity, is everywhere treated with the same courtesy and implicit confidence as though it were actually a quantity. The inquiry as to whether the laws of analysis are really applicable to this foreign intruder into the society of actual magnitudes, or whether it has to be governed by laws of its own, is nowhere deemed necessary. These remarks apply with equal force to other works on calculus and to works on algebra.

YOUNG, J. R. *Elements of the Differential Calculus*, comprehending the general theory of surfaces, and of curves of double curvature. Revised and corrected by Michael O'Shanneasy. Philadelphia, 1833. Pp. 255.

In the preparation of this American edition, the editor was assisted by Professor Dod, of Princeton College.

In the explanation of the process of differentiation, he makes  $h$  absolutely zero, in an expression like this:

$$\frac{y' - y}{h} = 3x^2 + 3xh + h^2.$$

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\* Ryan's Calculus is now a rare book. The copy we have before us was kindly lent to us by Prof. W. Rutherford, of the University of Georgia.



"In both these cases (of which that given here is one), as indeed in every other the respective differential co-efficients are only so many particular values of the general symbol  $\frac{0}{0}$ , to which  $\frac{y'-y}{h}$  always reduces, when  $h=0$ ." In the above example

$\frac{0}{0}=3x^2$ . "The expressions  $\frac{dy}{dx}$  and  $\frac{dx}{dy}$  have, we see, the advantage over the symbol  $\frac{0}{0}$ , of particularizing the function and the independent variable under consideration

and this, it must be remembered, is all that distinguishes  $\frac{dy}{dx}$  or  $\frac{dx}{dy}$  from  $\frac{0}{0}$ , for  $dy$ ,  $dx$ , are each absolutely 0." "These differentials, although each = 0, have, nevertheless, as we have already seen a determinate relation to each other (!); thus, in the last example, this relation is such that  $dy = 2b(a+bx) dx$ , and, although this is the same as saying that  $0 = 2b(a+bx) 0$ ; yet, as we can always immediately obtain from this form the true value of  $\frac{0}{0}$  or  $\frac{dy}{dx}$ , we do not hesitate occasionally to make use of it." It will thus be seen that the author has no hesitation whatever in breaking up the differential co-efficient.

YOUNG, J. R. *The Elements of the Integral Calculus*, with its applications to geometry and to the summation of infinite series. Revised and corrected by Michael O'Shannessy. Philadelphia, 1833. Pp. 292.

DAVIES, CHARLES. *Analytical Geometry and Differential and Integral Calculus*. 18—. ——— *Elements of the Differential and Integral Calculus*. 1836.

Several editions of Davies' calculus appeared. In the improved edition of 1843 (pp. 17 and 18) the author says that  $2ax$  is the limit toward which the ratio  $\frac{y'-y}{h} = 2ax + ah$  approaches in proportion as  $h$  diminishes, and hence "expresses that particular ratio which is independent of the value of  $h$ ." Bledsoe objects to this, saying, "Shall they (teachers) continue to seek and find what no rational beings have ever found, namely, that particular value of  $\frac{y'-y}{h}$  which does not depend on the value of  $h$ ? That is to say, that particular value of a fraction which does not depend on its denominator!" Davies represents by  $dx$  "the last value of  $h$ , which can not be diminished, according to the law of change to which  $h$  or  $x$  is subjected, without becoming 0." "It may be difficult," says the author, "to understand why the value which  $h$  assumes in passing to the limiting ratio is represented by  $dx$  in the first member and made equal to 0 in the second." To this Bledsoe says: "Truly this is a most difficult point to understand, and needs explanation. For if  $h$  be made absolutely zero, or nothing on one side of the equation, why should it not also be made zero on the other side?" "Why should 'a trace of the letter  $x$ ' be preserved in the first member of the equation and not in the second? The reason is, just because  $dx$  is needed in the first member and not in the second to enable the operator to proceed with his work."

As regards the conception of the term "limit," Davies believed that a variable actually reached its limit. "The limit of a variable quantity is a quantity toward which it may be made to approach nearer than any given quantity, and which it reaches under a particular supposition."

Davies believed that by the definition of M. Duhamel, according to which a variable never reaches its limit, there seemed to be placed an "impassable barrier" between a variable quantity and its limit. "If these two quantities are thus to be forever separated," says he, "how can they be brought under the dominion of a common law, and enter together in the same equation?"

\* *Nature and Utility of Mathematics*, by Charles Davies, New York, 1873, p. 281.

† *Ibid.*, p. 328.

PEIRCE, BENJAMIN. *An Elementary Treatise on Curves, Functions, and Forces*. Volume I, containing analytic geometry and the differential calculus. Boston and Cambridge, 1841. Pp. 301. Volume II, containing calculus of imaginary quantities, residual calculus, and integral calculus. Boston, 1846. Pp. 290.

The method followed in these volumes is the infinitesimal, of which the author was a great admirer. The differential co-efficients are here denoted by  $D$ ,  $D'$ , etc. The second volume treats of many rather advanced subjects, such as imaginary infinitesimals, imaginary logarithms, imaginary angles, the imaginary angle whose sine exceeds unity, potential functions, residuals, definite integrals, elliptic integrals, method of variations, linear differential equations, Riccati's equation, and particular solutions of differential equations.

CHURCH, ALBERT E. *Elements of the Differential and Integral Calculus*. New York, 1842.

This is in many respects a good work, but the explanation of fundamental principles therein contained is too brief, and fails to convey a philosophic knowledge of them. The difficulties which a student is likely to encounter in a treatise like this have been well stated by a writer in the *Nation* of October 18, 1838: "What vexes and perplexes him (the student) is that he seems to himself to comprehend very clearly what he is doing, and to be doing what all his previous training had taught him he must not do. It all seems very easy, very simple, and very absurd. He is told to 'take the limit' of one side of his equation by striking out a quantity because it 'is approaching zero,' while on the other side the same quantity must be carefully preserved, because it is one of the terms of the ratio which is the very essence of the whole process."

MCARTNEY, WASHINGTON. *Principles of the Differential and Integral Calculus, and their application to Geometry*. Philadelphia, 1844. Pp. 340.

The author makes use of the doctrine of limits, but retains the language of infinitesimals. " $\frac{dy}{dx}$  is used as a mere symbol to denote the ultimate ratio,  $\frac{dy}{dx}$  being in reality

0. But inasmuch as the rules for differentiating and the geometrical application of ultimate ratios are more readily understood by regarding the increments of the ordinate and abscissa as indefinitely small, we will call these increments in their ultimate state, *indefinitely small quantities*." "For the sake of convenience," the student is asked to call  $dy$  and  $dx$  what he has just been told that they really are not. Such an exposition of a *fundamental* principle is quite apt to fail to give satisfaction to beginners.

McCartney's Calculus is a book possessing several good features.

LOOMIS, ELIAS. *Analytical Geometry and Calculus*. 1851.

Later the Calculus was published in a separate volume and much enlarged. The unfolding of fundamental principles, as given in the improved edition of 1874, is less objectionable than that in the preceding works which adopt the method of limits. The term "limit of a variable" is here subjected to *definition*, but the student is not informed whether or not the variable ever reaches its limit. The symbol  $\frac{dy}{dx}$  is made to represent the limiting value of  $\frac{\text{incr. } y}{\text{incr. } x}$ . Confusion is apt to arise in the mind of the student from the fact that  $dx$  is "put for the *incr. x* in the limiting value" (which value is zero), and is afterward said to be "indeterminate" in value, "either finite or indefinitely small."

SMYTH, WILLIAM. *Elements of the Differential and Integral Calculus*. 1854.

The author uses the infinitesimal method, but says (p. 229) that "as a logical basis of the calculus, the method of Newton and especially that of Lagrange have some advantage. In other respects the superiority is immeasurably on the side of the method of Leibnitz."

COURTENAY, EDWARD H. *Treatise on the Differential and Integral Calculus and on the Calculus of Variations*. New York, 1855. Pp. 501.

The exposition of the method of limits, as given in this in many respects admirable work, is likewise open to objection.  $dx$  is pronounced to be "infinitely small" and equal to  $h$ , but when  $h=0$  at the limit,  $dx$  continues to remain indefinitely small.

ROBINSON, HORATIO N. *Differential and Integral Calculus*, 1861.

Some of Robinson's elementary works on mathematics became popular, but not so his advanced works. His calculus and astronomy met with able but severe criticism in the *Mathematical Monthly*. Robinson's work did not appear in a second edition, but the work of Quinby was added to "Robinson's Series" in place of it.

DOCHARTY, GERARDUS BEKKMAN. *Elements of Analytical Geometry and of the Differential and Integral Calculus*. New York, 1865. Pp. 306.

The part on the calculus covers 204 pages.

The method of limits is employed and treated in the manner customary with us at the time the book was written.

SPARE, JOHN. *The Differential Calculus: with Unusual and Particular Analysis of its Elementary Principles, and Copious Illustrations of its Practical Application*. Boston, 1865. Pp. 244.

This work I have never seen. Dr. Artemas Martin, who kindly sends me its title, calls it a unique work, as may be seen from the following, which he quotes from its preface: "The calculus being algebra, a strictly numerical science, the present treatise claims to have labored successfully in putting on the true character as such. No insinuation is allowed to prevail that it is any part whatever of analytical geometry or that it is other than the natural sequel and supplement of common algebra; useful, indeed, as an appliance, to borrow, in investigation of the few kinds of geometrical quantity."

QUINBY, I. F. *A New Treatise on the Elements of the Differential and Integral Calculus*. New York, 1868. Pp. 472.

Here, as in other works based on the method of limits, the student encounters at the outset the perplexing statement that  $\frac{0}{0}$ , where 0 denotes "absolute zero," is equal to some particular quantity.

STRONG, THEODORE. *A Treatise on the Differential and Integral Calculus*. New York 1869. Pp. 617.

This work was printed, but, we understand, never published. The author died while the work was in press. Theodore Strong was professor at Rutgers College from 1827 to 1873, and enjoyed the reputation of being one of the very deepest and most erudite mathematicians in America. He was a very frequent contributor to our mathematical periodicals. To students who possessed taste for mathematical investigation he was a good teacher, but to those who had no taste he was unintelligible. He had an unconscious tendency to diverge into regions where the ordinary student could not follow him. This same tendency is exhibited in his *Calculus*, and also in his *Elementary and Higher Algebra*, published in 1859. Both works possess many original features, but the novelties contained in them are not always improvements. These books are defective in arrangement, and not at all suited for use in the class-room. In his general view of the calculus Strong follows Lagrange, but his mode of presentation is quite new. He believed that his treatment divested the calculus of all its old metaphysical encumbrances. He attempted to show how the foundations of this science could be established without the intervention of any of the antiquated hypotheses. "It is hence clear," says he, "that the differential and integral calculus are deducible from what has been done, without using infinitesimals or limiting ratios" (p. 271).

PECK, WILLIAM G. *Practical Treatise on the Differential and Integral Calculus*, with some of its applications to mechanics and astronomy. New York and Chicago, 1870. Pp. 208.

Employs the infinitesimal method.

BESTINI, B. *Manual of Geometrical and Infinitesimal Analysis*. Baltimore, 1871. Pp. 131.\*

The infinitesimal method is used.

OLNEY, EDWARD. *General Geometry and Calculus*. New York, 1871.

The part on the infinitesimal calculus covers 152 pages. The infinitesimal method is used. It is the experience of the large majority of teachers in this country that the infinitesimal method, taken by itself, unaided by any other method, *does not seem rigorous to a student beginning the study of the calculus, and does not fully satisfy his mind.*

RICE AND JOHNSON. *The Elements of the Differential Calculus*, founded on the method of rates or fluxions. (Printed for the use of the cadets of the U. S. Naval Academy.) New York, 1874.

Without abandoning the ordinary notation, the writers return, in this work, to the method of Newton. Newton's method of rates or fluxions is employed in subsequent treatises written by the same authors, and also in the works of Buckingham and Taylor. By these writers much-longed-for improvements in the philosophical exposition of the fundamental principles of the transcendental analysis have been introduced.

JOHNSON, W. WOOLSEY. *Integral Calculus*.

RICE AND JOHNSON. *An Elementary Treatise on the Differential Calculus*, founded on the method of rates or fluxions. New York, 1877. Pp. 469.

RICE AND JOHNSON. *Differential Calculus* (abridged).

RICE AND JOHNSON. *Differential and Integral Calculus* (abridged).

CLARK, JAMES G. *Elements of the Infinitesimal Calculus* (in "Ray's Series"). New York and Cincinnati, 1875. Pp. 441.

The doctrine of limits is made the basis of this work. The author follows mainly the excellent philosophical treatises of M. Duhamel.

BUCKINGHAM, C. P. *Elements of the Differential and Integral Calculus*. By a new method, founded on the true system of Sir Isaac Newton, without the use of infinitesimals or limits. Chicago, 1875.

BYERLY, W. E. *Elements of the Differential Calculus*, with examples and applications. Boston, 1880.

The doctrine of limits is used as a foundation of the subject and preliminary to the adoption of the more convenient infinitesimal method. The notation  $D_x y$  is employed.

BYERLY, W. E. *Elements of the Integral Calculus*, with a key to the solution of differential equations. Boston, 1882.

BOWSER, EDWARD A. *An Elementary Treatise on the Differential and Integral Calculus*. New York, 1880.

Adopts infinitesimal method.

TAYLOR, JAMES M. *Elements of the Differential and Integral Calculus*. Boston, 1884. The author employs the conception of rates.

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\* A copy of this work was lent to us by Prof. J. F. Dawson, S. J., of Georgetown College, West Washington.

NEWCOMB, SIMON. *Elements of the Differential and Integral Calculus*. New York, 1897.

The author uses the method of infinitesimals, based on the doctrine of limits. An infinitesimal quantity is here defined as one "in the act of approaching zero as a limit." This definition of an infinitesimal has now been very generally adopted.

It has been said that years ago a cadet at West Point, extremely fond of mathematics, thus estimated the calculus: "The inventors of the differential and integral calculus have claimed that this branch of so-called science belongs to the department of mathematics, and, laboring under that delusion, have introduced it into the course of academical instruction for the torture of students. Such classification is obviously incorrect, because the principles of mathematics fall within the scope of the reasoning faculty. The calculus, on the contrary, lies without the boundaries of reason."\* That such should have been the impression received by the student of the early works on calculus is not at all strange. Our recent publications on the subject have, however, made decided progress in the philosophical exposition of the fundamental principles. With a modern book and a competent teacher there is no reason why the ordinary student should not get a *rational* understanding of the calculus.

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\* Life of General Nathaniel Lyon, p. 36. The passage is quoted in the *Analyst*, Vol. I, 1874, "Educational Testimony Concerning the Calculus."



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